THE

ELECTRICAL REVIEW.

VOL. LX. FEBRUARY 1, 1907. No. 1,523.

ELECTRICAL REVIEW.

Vol. LX.] CONTENTS: February 1, 1907. [No. 1,523.

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(J. A. BERLY'S).

1907 Edition

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TRAMWAY STATISTICS.

WHILE so much interest is being taken in the question of municipal tramway finance, owing to the approach of the County Council elections, it will be timely to direct our readers' attention to the statistical return which has just been issued by the Board of Trade concerning the tramways and light railways of the United Kingdom. The fact that the information relates to the year ended 12 months ago takes away from its value somewhat, but it has to be borne in mind that the collection and publication of such an enormous amount of statistical data in complete and fairly accurate form involves a great deal of labour, as well as a patience and deliberation such as only obtain in a Government department.

The progress of tramway electrification is not very rapid at present; for one thing, it has not been easy to raise money for any venture (even the romantic and fascinating Victoria Falls project failed "to draw"), and some money that might otherwise have gone to aid tramway enterprise has been put upon the wrong horse, by being sunk in the costly pioneering work of the motor-omnibus. These statistics relate to the period when that development was well beginning, and of the 214 miles that were added to the electrically worked lines during the year, we suppose the great percentage were in process of converting at the beginning of the period. The return that we shall have a year hence may indicate still less tramway advance. Yet it is noteworthy that there are still, or were at the date of the report, some 1,614 cars running by other than electric power (some 10,000 faithful steeds yet run their jog-trot pace), 1,357 of these cars being the property of private companies.

A point in this return that we think should be most severely criticised is the new practice now adopted by the Local Government Board of calling the difference between gross receipts and working expenditure *net profit*. This in previous years has been called *net receipts*. Changes of Government bring many things in their trail, but no change of Government on earth can make it either wise or justifiable for a great public Department to deceive its public by calling chalk cheese or a spade something else. Net profit indeed! Sir Herbert Jekyll signs this statement:—"Local authorities who work, as well as own, their tramway undertakings, have made a *net profit* of £2,529,752 on the year's traffic," *out of which* £663,336 is placed toward the reduction of tramway debt and £623,617 is carried to reserve and renewal funds. To describe it as *net profit* before these items have been met, in view of the heavy track repairs and renewals that are continually being found to be necessary beyond original anticipations, and seeing that Glasgow finds it necessary to set apart £500 per mile per annum for such contingencies, is little short of absurd. Many places are finding their reserve and renewal funds very necessary indeed, and without these to draw upon they would have had to raise fresh loans to provide for the

efficient upkeep of the undertaking, thus piling up capital account without in any degree adding to the revenue-earning capacity of the system. How on earth, then, can a renewal fund be described as net profit if a good proportion of it be needed to keep the undertaking merely in a state of working order? Properly speaking, it is a maintenance charge, and is therefore an ordinary working expense. We thought the Local Government Board was exercising a firmer grip upon local authorities in regard to their finances, but it certainly ought never to have let this return go forth to the world at election time with that term *net receipts* altered to *net profits*, unless, as in its President's ridiculous speech regarding the *Standard's* tramway criticisms, it wishes to take sides in the coming election. The modest sum of £205,911 has been placed to relief of rates. The capital expenditure off which that £663,336 is written for reduction of tramway debt, and in respect of which £623,617 is carried to reserve and renewals, is £37,156,460; together they are thus less than 3½ per cent. "Interest or dividend" reqnired (or, speaking quite precisely, is set down as) £840,225, an average rate of only 2·3 per cent.

Now, in regard to that £205,911 which has been placed, by the country as a whole, in relief of rates: against this it is only fair to set the towns where losses are reported, and to add to such losses what ought to have been paid in those instances for interest, reserve and renewals, and so forth. In that way only can we get the net financial result of municipalisation for the whole kingdom. Certainly it would not require any straining of the case to show that, so far as relief of rates is concerned, the country is little the gainer. Individual cases may show a benefit, but these are not to be regarded as the whole.

ADVISORY BOARDS FOR UNIVERSITIES.

An announcement of a highly interesting nature was made a few days ago in the statement that the Council of the University of Birmingham had decided to establish an Advisory Board of business men to co-operate with the Professors in the Faculty of Commerce; the functions of the new Board being, first, to make suggestions with regard to the training of students for business careers; and, secondly, to bring the Faculty and the graduates it produces before the notice of the business world.

At the time when it was inaugurated in Birmingham, some six years ago, the very idea of a Faculty of Commerce was, we believe, new to the University mind. The departure has proved a success, as is shown by the fact that more or less similar sections have been founded in other educational establishments abroad, if not at home; but there is a feeling that its success might have been even more marked if the methods adopted and the results obtained already had become better known. If it is true that a Professor on the science side experiences difficulty in keeping his instruction on a level with the advances that are constantly being made outside his Institution, unless he himself has been, or is periodically, engaged in actual practice; the same remark must apply with perhaps greater cogency to the man who undertakes to teach "business," because of the secrecy in which so many trading concerns enwrap themselves, and the contempt they are apt to bestow upon all their rivals' methods.

Were there not at present insuperable obstacles of a financial character in the way, it would be an excellent rule for Universities and the like to adopt, only to appoint as teachers men who had proved themselves capable of getting together a consultancy worth so much per annum, and only to retain them for a limited period of time. This being impossible, however, the next best thing is assuredly an Honorary Advisory Board to help the teachers whenever suitable and successful men of affairs can be persuaded to accept the task. Hence the Birmingham plan is warmly to be welcomed, especially in the form given it. A committee of eight gentlemen has been created, the names of its members being well known in financial and industrial circles as those of men ably fulfilling responsible posts. For the moment they have only been formed into a committee experimentally, with a corporate lifetime of two years; but if the scheme succeeds, as it emphatically should, the Board will be permanent, though the activity of each member will be restricted to a comparatively short period, in order that "new blood" may bring new ideas, and representatives of other industries introduce other notions. Birmingham is certainly to be congratulated on possessing a University Council sufficiently liberal-minded to invite, instead of resenting, outside aid and criticism, and also upon comprising among her citizens busy men of the world ready to assist the University and the rising generation.

A little thought on the lines we have been sub-consciously following will show that this new departure is one which is capable of imitation in other directions with great benefit to all. If the work done by the recently created, highly modern Faculty of Commerce in the Birmingham University is likely to be rendered more valuable to its students and their future employers than it is now by the co-operation of an Advisory Board of business men, there can be no doubt whatever but that the instruction given and the ideals presented to students undergoing specialised training in other branches of knowledge within other educational establishments of university and lower rank, would be rendered more valuable to, at least, an equally marked degree if the Professorial Staff were assisted by an advisory board of consultants in the subject concerned. Very much has been said and written of late years about the importance of research, but the need for avoiding what has been termed "machine-made" research, and for directing the investigations into useful courses, has been unduly kept in the background. Two points are constantly striking the student of technological literature with very great force. In the first place, almost whenever he is seeking to ascertain whether any work has been done in a certain branch of science just outside the lines laid down by the writers of the first text-books—any experiments upon a point which may obviously at any moment become practically important—he draws blank. If a reader of the newspapers, he finds the leading experts expressing diametrically opposite opinions upon a simple matter in Court, manifestly because no one has considered the question before, although it was one bound to crop up sooner or later. In the second place, the student finds the "Transactions" of learned societies growing bulkier year by year, containing more and lengthier communications; and he sees those communications to be of the same kind of pointless research, describing (to take an example from chemistry, as one of the worst offenders) new compounds devoid of all interest or importance, prepared and examined in a cut-and-dried fashion, frequently without reference to the balance: compounds whose existence would be taken for granted by every undergraduate, and whose very properties could be accurately foretold by every adept. An Advisory Board of practising engineers to consult with the teachers of engineering, in each of its main branches; of chemists to co-operate with the Professors of chemistry; perhaps, too, a joint Board of professional editors and practising men of science to assist the publication committees of our various "heavy" Society journals might do much good throughout the whole technical world.

As bearing not too remotely upon this subject, the speeches made last Monday at the Mansion House in the course of the first annual meeting of the British Science

Guild are well worth reading. Such speakers as Mr. Haldane, Sir Norman Lockyer, and Canon Lyttelton, headmaster of Eton, regarded with equanimity, if not with enthusiasm, the manner in which a conviction of the enormous value of science was growing in the minds of our fellow countrymen, as much amongst our employers as in the ranks of the future employed. The speakers said that the salaries paid to technical men were increasing, that schoolmasters were beginning to realise the need for other things beside literary work, and that even in the British Army there was at the present time an average of scientific attainment such as had never been seen before. Perhaps, then, if the labours of the British Science Guild are not too esoteric and diffuse to be effective, that youthful society may provide members for such advisory boards as we have sketched above, furthering in this and other ways the advancement of science and the application of its methods to industry in the manner we all have so much at heart.

Copper.

During the past month (January) the general features of the copper position have undergone no marked changes. The demand remains constant, and has a tendency to increase, as buyers who hold off owing to the price are eventually compelled to come in. The relief to be expected from the opening of new mines and re-working of abandoned ones cannot come into operation for a matter of six months, and meanwhile the price must be maintained. The anticipated prices throughout the month generally support this view. The depression in Standard during the first half may be ascribed to determined selling on the part of important dealers rather than to an actual tendency to re-adjustment of the relation of supply to demand.

Much was expected of the Australian properties, and the consequent London buying resulted in something like a boom for the South province. The shares have, however, dropped on profit-taking, indicating the uncompleted state of the production. The visible supplies at mid-month were unusually high, even for January, amounting to 17,461 tons. This may or may not be regarded as an indication of increased output, but it will be remembered that, in the same month last year, the supplies were over 16,000. With the increasing demand it does not appear likely that conditions will be easier before August; any strong movement before the new mines begin to make themselves felt must be regarded as artificial. The market exhibits, however, a certain nervousness, and may show some such temporary jerks as were exhibited by so strong a metal as tin last July.

London's Power.

With characteristic obstinacy the Spring Gardens authority on Tuesday spread out its four feet, fixed them tenaciously to the green sward, and declined to budge an inch from the position it took up last November regarding London power supply. By 77 votes to 34 it confirmed its earlier decision and will proceed with its 1907 Bill giving but supercilious gesture to the Finance Committee and all its warnings. For which wasteful sin we hope and verily believe it is now well on the way to the block for public execution in the windy month of March. Really it is a pretty spectacle that is presented to us by the developed position of this scheme. The Council is divided against itself, is opposed by large numbers of existing borough councils, is opposing, and is opposed by, parties who have other schemes for Parliament to consider. Meanwhile the ratepayer whom councillors (both County and Borough) are supposed to represent is indeed in an interesting position. Into his pockets both bodies dip in order that they may bludgeon one another before Parliamentary Committee! He has the privilege of paying both ways. What *do* the electors think of this effect of municipal misgovernment? If they do not say away with your wasteful grandmotherly interference—well—we shall be surprised!

PETROL-ELECTRIC OMNIBUSES.

At a meeting of the Society of Motor-Omnibus Engineers, held on Monday, the 21st ult., at the Hotel Cecil, a paper was read by Messrs. E. W. Hart and W. P. Durtnall, entitled—"Petrol-Electric Transmission for Road Vehicles in Comparison with Purely Mechanical Systems."

The title of the paper raised hopes that the two systems, viz., the mechanical and the mixed mechanical and electrical, would be compared, both as to cost and performance. Such hopes were not fulfilled, as the paper consists entirely of a descriptive *résumé* of the various attempts which have been made to produce a satisfactory road vehicle combining the advantages of the petrol engine and the electric motor drive.

As such, the paper forms a very useful addition to the literature on the subject of mechanically propelled road vehicles. It was pointed out by the authors that the chief object aimed at in introducing electrical transmission on petrol cars was the elimination of the gear box, which is a very prolific source of breakdowns.

The following brief summary of the various systems described will sufficiently indicate the scope of the paper:—

The Patton System (1890) was among the earliest mixed systems to be employed. A small petrol engine was kept always fully loaded driving a dynamo which charged a set of accumulators. The accumulators in turn supplied current to two electric motors which propelled the car.

The Dowsing System.—In this system a petrol engine and dynamo are belted to the road wheels. An accumulator is also carried which is charged by the dynamo when the full power of the engine is not absorbed by the vehicle. On inclines, the dynamo becomes a motor driven by the accumulators, thus assisting the engine.

The Germain System.—A petrol engine drove the magnet system of a revolving field continuous-current dynamo. The armature of the dynamo was coupled directly to the armature of a similar motor, and through the latter to the car wheels. Both motor and dynamo were series-wound and formed an electrical coupling between the engine and the wheels.

The Hart System was introduced in 1903. A 40-H.P. petrol engine was coupled to a direct-current dynamo which supplied current through a series-parallel controller to a double-wound motor. With a tonneau body the car weighed 25 cwt., and it is said that a speed of 50 miles an hour could be easily attained.

The Mildé System.—A dynamo was coupled to the engine, and each of the rear wheels was driven by a compound motor. A battery also was used, which could be recharged from the motors in descending hills.

The Fisher System.—In this system a 22-H.P. petrol-driven dynamo supplied current through a series-parallel controller to two 7½-H.P. series-wound motors, which were geared to the rear wheels. A battery of 150 ampere-hours' capacity was charged by the dynamo, when the total power developed was not taken by the motors.

The Hart-Durtnall continuous-current system is a modification of the above. The battery is eliminated, and the field windings of the dynamo and motors are sub-divided, so that more or less may be brought into circuit as desired. Starting with all the motor windings in circuit, those of the dynamo are brought step by step into circuit by means of a sliding switch. In this way the voltage is gradually raised, and the car starts up without jerk. When the dynamo has its full field, increased speeds are obtained by cutting out portions of the motor windings. The full range of speed is, therefore, obtained without any resistances being used.

In the *Astle-Wallis* combination a 10-H P. petrol engine is coupled through a friction clutch to a 2-B.H.P. electric shunt-wound machine, which may be used either as motor or generator; an accumulator is also used. The car is started by means of the electric motor driven from the accumulators. The engine then takes up the running, and by means of a controller the electrical connections can be varied, so that the battery is either charged from the

dynamo, or the latter, acting as a motor, assists the engine, say, in hill climbing. By this arrangement a smaller engine can be used than would be necessary without the assistance of the motor. In coasting down hill the braking power is used regeneratively to charge the battery, no mechanical brake being used.

The Stevens System.—The petrol engine is coupled directly to a dynamo with two commutators and double armature and field windings. Each of the rear wheels is driven by a separate motor. By means of the controller the motors and the dynamo windings can be put in series or parallel as desired.

The Carolan System.—Engine, dynamo, and motor are coupled in line, with a differential gear between the dynamo and motor. The car is started up through the dynamo and motor, a direct drive being obtained when the speeds of both are equal.

The Kriëger System.—The dynamo, designed for constant watts, coupled to the engine, has two shunt windings, one for self-excitation, and one excited from a battery; also a series winding opposing the shunt. The motor has a series-field winding sub-divided and connected to a controlling switch, also a demagnetising coil excited by the dynamo. The car can be started from the accumulators.

The Piëper System, known also as the "Auto-mixte" system, consists of a petrol engine coupled to a shunt-wound dynamo, which is connected through a controller to an accumulator. The battery is used for ignition purposes, for starting the car and for regulating the fuel supply to the engine. The electric machine acts either as a dynamo to charge the battery, or as a motor to help the engine on inclines, and to start the car. A differentially-wound solenoid controls the admission of the gases. A discharging current tends to open, and a charging current to close the throttle. The self-induction of the sparking coil can be varied by inserting or withdrawing an iron core. An electro-magnetic clutch is interposed between the dynamotor and the bevel gear on the back axle.

The Farrow system closely resembles the Piëper system, including engine, dynamo, accumulator, and magnetic clutch. When descending hills or running backwards all compression is taken off the cylinders and the throttle closed. This permits of full advantage being taken of the regenerating effect.

The Hart-Durtnall system differs from all the foregoing in that polyphase alternating current is used instead of continuous. A 40-H.P. engine is coupled to a three-phase generator combined with a series-wound exciter. An induction motor is coupled to the propeller shaft, and an electro-magnetic clutch is interposed between the motor and the generator. The propeller shaft drives the live back axle through a differential gear. The motor has its stator windings arranged in two groups, by means of which two running speeds can be obtained.

The operations are as follows:—The engine is first run up to full speed, with the two-speed switch in the top-speed position. The exciter regulating switch is then brought up step by step until there is enough voltage on the induction-motor terminals to produce sufficient torque to start the car. The excitation is then gradually brought up to its maximum value, when a further movement of the switch puts the magnetic clutch in series with the generator field. This brings the clutch gently into circuit. The last movement of the switch short-circuits the field of the generator, the clutch windings only remaining in the circuit of the exciter. To start the car on a gradient, the two-speed switch is put over to the half-speed position. A pedal brake is used to stop quickly, and this causes the exciter field to be short-circuited before the hand-brakes are applied.

A discussion followed the reading of the paper. The chairman (Mr. Shrapnell Smith) commented on the fact that the authors had to use a commutator on their exciter, notwithstanding their severe strictures on this continuous-current accessory. He had ridden on the Hart-Durtnall 'bus, and had never been on any other 'bus so easily controlled. The additional weight involved by the addition of the electrical equipment was said not to exceed 500 lb.

Mr. Carter, secretary to the Motor-Omnibus Co., said he had also ridden on the author's 'bus, and was much impressed with the ease of control and the electrical braking in descending hills. The control, he said, was as easy as advancing the spark on a De Dion 'bus.

Mr. Clarkson, of Chelmsford, complained that no comparative data were given, and pointed out that the limitations of the 'bus were those of the petrol engine. He regarded all those petrol-electric systems as ingenious attempts to equal the good features of the steam-motor-'bus.

Mr. Bernard Hopp, of the B.T.-H. automobile department, read a lengthy criticism of the system. He admitted that a petrol-electric system eliminated the principal defect of the petrol 'bus, viz., the noise due to the gear, and that there was less wear and tear. He, however, argued that, given a properly designed traction motor, the continuous-current system was preferable to the polyphase.

Mr. T. Parker, jun., gave some interesting reminiscences concerning accumulators and alternators, and Messrs. Weekes, Blake, Markham and others joined in the discussion.

THE COST OF LIVING IN EGYPT.

By F. C. SYDNEY HANAUER.

Egypt has been somewhat prominently brought before the public of late, and the idea, has, no doubt, entered the minds of a number of men that it is just the country to make a fortune in. To any men who cherish this idea, my advice is that they had better not come out, but stay at home and keep on cherishing their ideas. Egypt is no longer the Eldorado it was 30 or 40 years ago. Wages are not very high, or proportionate to the living expenses. This is due to the fact that there are a number of Belgians and Germans here who will work for a salary that just covers the cost of living.

I should not advise anyone to come out to Egypt for less than £18 a month as a start. In fact, this is the lowest sum any single Englishman can live on. He will be able to live comfortably, but will not be able to afford any luxuries out of this sum. Board and lodging with an English family, or pension, usually run between £9 and £12 per month in Cairo. In Alexandria the expense is not so great. Further south is more expensive. In Assouan, for instance, a man would have to reckon to spend about £14 or £15 if living alone. In the Sudan, the expenses are still greater, and I do not think it would be wise for anyone to go there from England unless he could be sure of obtaining £25 a month. Just lately some young Englishmen went up to Khartoum at salaries ranging between £15 and £18 per month. Needless to say, they are just keeping themselves. They are furnished with a house by their employers, but have to provide everything else themselves.

A word about clothing. A good supply of light underclothing for summer wear should be brought out, besides some light woollen clothes for winter. All kinds of men's underwear are obtainable in the large towns, but they are naturally more expensive than anything obtained in England. Men's suits range between £3 10s. and £7. A helmet is necessary for summer wear, but this is obtainable cheaper here than in England. Boots and shoes are rather expensive, and had better be brought out from England.

With reference to languages, the more a man can speak, the better. In the Sudan only two are really necessary, viz., English and Arabic. This latter is usually picked up in the country one is to live in. In Egypt, the principal commercial languages are English, French, Italian, German and Arabic. Arabic is the most important, next in order come French and Italian. Most of the European workmen speak Italian and Arabic. Very few speak English. Native labourers speak no other language but their own.

In conclusion, I would not advise anyone to come out on speculation. Good jobs are not very plentiful in this part of the world now, and as soon as there is a vacancy there are plenty of applicants who, owing to their knowledge of the country, would stand a better chance of obtaining it than a newcomer.

[In the interests of our readers, we cordially welcome information of this nature, and we shall be glad to receive similar particulars from other friends resident abroad. The following letters have appeared in our pages recently :—Cost of Living in the South American Republics, Vol. 59, p. 660; Cost of Living in Brazil, Vol. 59, p. 1031.—Eds. E.R.]

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Cramp Neutralised Repulsion Motor.

I gather from a report of Mr. Cramp's paper read before the Manchester Section of the Institution of Electrical Engineers on January 8th, that when speaking of his "neutralised repulsion motor," which, by the way, he now refers to as a modification of the series motor, he made the following statement : "It will be remembered that after that meeting my suggestion was much criticised in the electrical Press, one gentleman first stating that such a motor would have a low power factor, practically no torque, less efficiency, not really a series characteristic, &c. ; while afterwards he practically admitted that he did not understand the machine, and asked for a full theoretical explanation."

Now this tirade, which is a deliberate mis-statement, can only apply to me, for I was the only one who criticised Mr. Cramp's motor in the electrical Press. The correspondence on this subject will be found in the Electrical Review for 1906, Nos. 1,481, 3, 4, 5, 6, 7, 8 and 1,490. Had I been in Mr. Cramp's position, and had I intended to make the above statement, then I should certainly have given the "one gentleman" a warning and the chance to be present at the meeting in question. Mr. Cramp's ideas of fair play and mine are evidently quite different, for he omitted to do this, and I must, therefore, ask you, Sir, to allow me to refute Mr. Cramp's statements with as much publicity as I can yet secure.

I have *never* admitted, as Mr. Cramp now suggests, that I did not understand his motor, although I will say that I have quite made up my mind that Mr. Cramp does not understand it himself. What I have never understood, and what I do not understand at this present moment, is how it is possible for anybody publicly to put forward the extravagant claims enumerated by Mr. Cramp in connection with his motor (see Table VIII of his paper) without even clearly appreciating the factors likely to determine the operation of the machine in question. My position in this respect was very clearly defined in my letter dated May 26th, 1906, where I say : "It has been my desire from the first to hear from Mr. Cramp how his motor operates according to *his views*. *I have stated mine* on the subject, and will continue to hold them until Mr. Cramp can prove them to be wrong. If Mr. Cramp cannot state the theory of his motor now, I must wait until he can do so, and I hope he will at the same time give us the data I asked for in my last letter."

In his reply (June 11th) Mr. Cramp pretended to be greatly incensed at what he terms my unreasonably large demand, and although he then, nevertheless, magnanimously promised to comply with my request, he has not done so to this day, for I do not suppose that he himself believes in the weak attempt at an explanation which he offers in his paper. Therein he explains the plain series conduction motor, but not his so-called "neutralised repulsion motor." But is it taking too great a liberty to ask the inventor to give an explanation of his own invention ?

It is lucky indeed for Mr. Cramp that his experimental motor was delivered so late and got conveniently short-circuited in time for the meeting, for I am as certain as theoretical considerations can make me that Mr. Cramp's motor will possess to the fullest degree all the defects which I have enumerated, so that his tests would have convinced nobody. My theory was very fully set out in my letter of May 12th, 1906, so that it will suffice if I now briefly recapitulate my principal contentions.

1. The machine has nothing whatever to do with a so-called "repulsion motor." All "repulsion motors" are of the induction type, and therefore neutralised *ipso facto*. Mr. Cramp's motor is a *conduction motor* of that useless shunt type, in which the E.M.F. responsible for the motor field is practically co-phasal with the E.M.F. conveying the energy to the armature. The small leakage flux threading the armature is a redeeming feature, but is too small to be of any practical value ; whatever advantages may accrue from it are outweighed many times by the sacrifices made to secure this leakage.

2. The winding B (see fig. 1), from which the energy necessary for the operation of the motor is conveyed to the armature by conduction, is in the worst possible inductive relation to the winding A from which it must receive its energy by induction. This means that the weight efficiency of the transformer (A — B) on which the operation of the motor primarily depends, must be very small, therefore the total efficiency must be very small.

3. The phase of the motor-field, *i.e.*, the phase of that flux which threads limb 2 of the motor, mainly depends on the transformer flux ϕ produced by coil A. This flux will be materially constant as long as E_1, the E.M.F. at the terminals

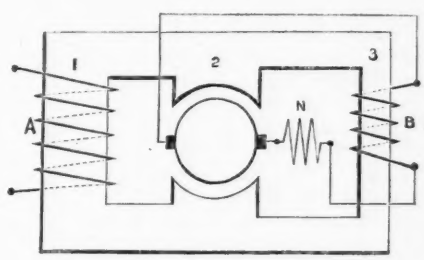

Fig. 1.

of A is constant, the distribution of ϕ between the limbs 2 and 3 will vary, amongst other things, according to whether B is loaded or not. Let us call ϕ' that part of ϕ which threads limb 2 and ϕ'' that which threads limb 3.

When the circuit of B is closed, for instance, by connecting it to the armature, then the resulting current I_2 will set up a flux ϕ_2 practically in phase with I_2. Some of that flux ϕ_2 will thread A, and cause that winding to take a current from the mains, one component of which will supply, as before, the magnetising current flowing through A, and determined by E_1, and another component of which will be of opposite phase to I_2, and will set up a flux ϕ_1 opposed to ϕ_2, and, therefore, neutralising the latter, or at least part of it. If that were not so, then an output might be obtained from B without a corresponding input into A. A fraction of both ϕ_1 and ϕ_2 will not thread both A and B ; let us call this fraction ϕ_3. The greater part of ϕ_3 will leak through limb 2, and thus influence to a small extent the magnitude, and in most cases, also, the phase of the resulting motor-field ϕ_m. In any case ϕ' will always be by far the greater component of ϕ_m.

Note that ϕ_3 is in any case only a fraction of ϕ_1 and ϕ_2, that ϕ_3 will be the greater for a given I_2 the smaller the reluctance of limb 2, therefore the smaller the mutual induction between the windings A and B. It is then apparent that in order to make ϕ_2 large for a given I_2, the reluctance of limb 2 must be small ; if, however, the reluctance of limb 2 is small then it is obvious that I_2 can never be large because then the transformer (A—B) is at its worst. The conclusion is that ϕ_3 must always be much smaller than ϕ', and that the phase of the motor field is, therefore, materially the same as the phase of the transformer field ϕ due to E_1.

4. The secondary E.M.F. induced in B is E_2, lags 90 behind ϕ, and is impressed on the armature by conduction *viâ* the brushes. At starting we can then have two extreme cases :—

(*a*) The secondary current I_2 is in phase with E_2, then the power factor may be fairly good, but the torque will be practically nil. It will be noted, therefore, that a neutralising

winding such as N must for this motor lower the output for weight, whilst it will improve the power factor a little.

(*b*) I_2 lags 90° behind E_c, then the power factor is zero and the torque a maximum.

As will be well understood the phase I_2 will, in practice, occupy an intermediate position, and we will have neither a good power factor nor a good torque per ampere.

As soon as the motor begins to rotate, a back E.M.F. (E_3) is set up at the armature brushes. Its magnitude depends on the speed of rotation and on the magnitude of ϕ_m, its phase on the phase of ϕ_m, and its direction on the direction of rotation.

Note to begin with that E_3 can never actually oppose E_2, for E_3 depends for its phase on ϕ_m and ϕ_m is practically in quadrature with E_2. The resultant of E_2 and E_3 will now be responsible for I_2, and whatever the direction of rotation this resultant will with increasing speed always tend to approach the phase of ϕ_m; a speed will, therefore, very soon be reached when I_2, which, as we have seen, lags behind the E.M.F. to which it is due, will be in exact quadrature with ϕ_m; at that instant the torque will become nil, no matter how great ϕ_m and I_2. The no-load speed will therefore be very limited. The motor will have a series characteristic of sorts, not because it is a series motor, but because it is a badly designed shunt motor.

Now, Sir, I have again stated my case against the Cramp motor, knowing full well that an experimental machine is ready for testing except for that bad short of which we have heard.

If Mr. Cramp cannot disprove my contentions theoretically, let him at least do so experimentally, now that he has the chance.

Mr. Cramp evidently resents criticism; in that he is very wrong—he ought to welcome it. If he is right, it can only strengthen his position; if he is wrong, it will no doubt save him money; in any case, it will probably teach him something. I see nothing derogatory in acknowledging any mistake one may make.

I hope, for Mr. Cramp's sake, that he will succeed in refuting my contentions; if he does, he will give me the opportunity of showing him that I am no more afraid of admitting that I am wrong than I am of maintaining, as long as I can fairly do so, that I am right.

Val. A. Fynn.

London, S.E., *January* 21*st*, 1907.

Electrical Contracting in India.

In your issue of December 28th, 1906, you refer to the electric installation for the Amir's Camp, Agra, and state that only one firm in Calcutta could be found to tender.

This statement is quite incorrect and misleading, as well as the insinuation that firms in India are not capable of dealing from stock for an installation of this nature.

As representative of an English firm in India, I wrote to the Royal Engineer officer superintending the Camp, some three months before the date of the visit, and I received a courteous reply to the effect that they required nothing at all, and had all that was necessary.

Had we been requested to tender, we should have been able, as would also several other firms we are acquainted with in this city, to have supplied dynamos and other electrical plant for a very large portion of installation, if not the whole, or at any rate with co-operation with other firms, we could have supplied more than enough power, and also all that could be required in arc lighting, wiring, incandescent lighting, &c.

Firms established in India have a most serious complaint in regard to the treatment they receive at the hands of the Government, and Government controlled railways. So strict are the limits of the value for which orders may be placed locally, that almost every engineering requirement must be indented for from home, and branch offices and agencies of home firms who lock up heavy capital in keeping a large and varied stock in India are quite overlooked.

Government officials sometimes excuse the Government action by stating that prices of material are so much higher here than they are when material is purchased from home, but this statement is quite incorrect, and, to my knowledge, prices tendered for similar material from home firms have been considerably in excess of local prices; in fact, prices are so cut in India, that in many lines there is scarcely any profit to be made. Further, in considering prices, the fact that the local firm takes all responsibility for breakages at sea and all risks in discharging, storing and dispatching, is usually ignored, and when, in some lines of goods, breakages as high as 25 per cent. take place and cannot be covered by any insurance policy, this risk is a most serious matter, and should not be overlooked.

People at home cannot understand or realise what competition is in this country. A native desiring to put light into a small factory up country comes down to the nearest large city and begins by sending round to every firm for tenders. The three lowest are possibly picked out, A's tender being highest. He visits A and shows him C's tender, the lowest, and asks him if he cannot quote a little lower than C. A naturally comes down, thinking the job would be his, but the buyer has not finished yet, and he shows A's amended tender to B, and B comes down below that, then he finally visits C and shows him both A's and B's tenders, which are now lower than C's, and promises him the work if he will come below B's tender. He does not mind if it takes him a month, provided he can only beat the price down, and in beating it down he always does succeed.

T. D. P.

Bombay, *January* 12*th*, 1907.

[Our correspondent who furnished the note in question seems to have been right in the main; he said "only one Calcutta firm," which is very different from "only one firm in Calcutta," and his statement regarding the neglect of local contractors by Government departments is fully borne out by "T. D. P." The conditions with which contractors have to contend in India seem to be peculiarly trying; at the same time, to take advantage of a breach of confidence, such as that described above, by lowering one's tender below that of one's competitors, can only be expected to bring its appropriate reward.—Eds. E.R.].

Metallic Filament Lamps and Side-Street Lighting.

With reference to the recent articles in your "Correspondence" columns on "Metallic Filament Lamps," I should like to add thereto my experience of the tantalum lamp.

At the beginning of last autumn these lamps were introduced to our private consumers, who have since taken them up with marked rapidity, and they now form a considerable portion of the total number of consumers' lamps. In every case, as far as I am aware, the utmost satisfaction is being obtained.

Turning to the all-important question of street lighting, I mean principally side-street lighting, as, of course, to all unbiassed people, for lighting main thoroughfares the ideal lamp is the arc lamp; but for less important streets, my experience is that the tantalum is certainly one, if not *the* best lamp for this purpose yet made, and it has filled a long-felt want in this direction.

For some months now I have had several pairs of these lamps in use on our public lighting posts (burning two in series on 200 volts) with excellent results. Their average life I have found to be considerably over 1,000 hours. By this I do not mean that it is wise to overrun them, any more than it is with other filament lamps, but my experience is, that even after 1,000 hours (for I have had none fail under this) they do not from the man in the street's point of view appear overrun. By this I mean that their drop in candle-power does not appear sufficient to make it absolutely necessary to change them, although perhaps advisable. This, then, surely is a point in their favour for street lighting, for, after all, what is required for this purpose, apart from a lamp of good illuminating power with a high efficiency, is one which is reliable. This, to my mind, is a most important point to be taken into consideration when deciding what lamps to adopt for our side streets, as, from a prospective consumer's point of view, if there is one thing more discouraging or one which will tend to drive them away more than another, it is inferior or irregular public lighting. As a motto, therefore, to all who are about to undertake any public lighting schemes, I would

say—"Make a first-class job and one that is a credit to the electricity department, or leave it alone."

Unfortunately, in the past, the lighting of our side streets by electricity has been greatly handicapped by the want of a suitable and at the same time *reliable* lamp. With the advent of the tantalum, the difficulty should no longer exist, for it is a most powerful weapon in the hands of electrical engineers in fighting their opponent, the gas mantle.

Sidney E. Day,
Borough Electrical Engineer.

Corporation Electricity Works,
Bury St. Edmunds,
January 26th, 1907.

Prof. Silvanus P. Thompson forgot to reply to the main point of my letter, viz., that he did not inform his audience that his tantalum lamps were on an alternating-current supply. The comparison which he made with another lamp had, therefore, no value.

'Appy 'Ampstead.

P.S.—I am running tantalum lamps on the Hampstead supply with more fortunate results.

Re Mr. Boot's letter in last week's issue—would he mind saying whether the time switch he eulogises is his own invention? It is quite likely that such an unimportant item would not occur to a man of Mr. Boot's well-known modesty, but it would be interesting information and help in appraising his recommendation at its true value.

Nothing Like Leather.

Technical Literature.

In connection with the interesting and instructive article by "W. M. M." on the above subject in your issue of the 18th inst., and more particularly with what he aptly calls the "immense fluid mass of technical literature continually being poured forth in the form of papers and contributions to the technical Press," &c., it may be of interest to some of your readers to know of a scheme recently put into operation at the School of Technology, Manchester, whereby attention is called to the more important articles appearing each week in the electrical journals, and a permanent record in the form of a card index is made at the same time for future reference. About a dozen weekly and half-a-dozen monthly electrical papers are taken in the school library; each one of these is allocated to a member of the staff, whose duty it is to read the current issue, and enter on special cards provided for the purpose, the titles and authors' names, together with very brief descriptions of the most important articles. The cards are of the standard size and shape for filing cabinets, and are made up in the form shown below:—

EE	*No.*.....	Ref.
	ELECTRICAL REVIEW.	
	Title.....	
	.....	
	Author..... *Date*...../...../.....	
	Description: *Page*.....	
	.....	
	.....	
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	.....	

Each abstractor is provided with a folding card, which he can carry in his pocket, and which contains a scheme of symbols for classified references in electrical engineering. This consists of a number of headings, the initial letters of which form the reference symbol, and of sub-headings which are designated by numbers, for example:—

DE—DESIGN.
1. A.C. generators.
2. A.C. motors.
3. C.C. generators.
4. C.C. motors.
5. Rotary transformers.
6. Static transformers.
7. General.

The abstractor would thus enter the reference to a paper on the design of rotary transformers in the top right-hand corner of the card as DE 5. These cards are placed in a rack in one of the main corridors, and remain there during the time that the periodicals in question are to be seen in the reading room; at the end of that time they are removed and arranged in the filing cabinets as a card index.

This plan is, of course, best carried out in libraries and technical institutes where the papers can be consulted on the spot, but there is no reason why it should not also be followed in offices and works where a number of technical journals are taken privately by the employés, who would act as abstractors.

There are, of course, several valuable publications, such as Science Abstracts, Engineering Indexes, &c., where references may ultimately be found, but the plan outlined above seems to possess the following advantages over them: first, in that it affords a bird's-eye view of the *important current* literature; and secondly, when carried out in connection with a library, the card index informs the searcher as to the references in periodicals which are all *contained in that library*.

Alfred Schwartz.

Manchester, *January 23rd*, 1907.

Wireless Telegraphy and the Admiralty Agreement.

For a mere man in the street such as I, there is an almost irresistible impulse to get up and execute a war-dance on reading Mr. Cuthbert Hall's brave strategical step to the rear. At last; at last, amid a shower of gay threats in the approved Cuthbert Hall method, he admits, in fact, what he has hitherto denied. This entire correspondence, since Mr. Hall's first letter, has been concerned with a particular official document—namely, the agreement between the Admiralty (called in the body of the agreement "The Commissioners for Executing the Office of Lord High Admiral of the United Kingdom of Great Britain and Ireland)" and the Marconi Wireless Telegraph Co., dated July 24th, 1903. It is printed as a Parliamentary Return numbered Cd. 3,047, 1906. Price 1d.; issued by H.M. Stationery Office, and can be purchased either directly or through any bookseller. It is this official document, and this alone, that is in question. I have several times alluded to it, and in a former letter I quoted entire the schedule to the agreement. That schedule (comprising such apparatus as the Admiralty, if it purchases any more, is still bound to purchase from the Marconi Co.) is confined, as I have pointed out, solely to certain jiggers and trays of Leyden jars. The fact is plain on the face of the agreement, and cannot be altered by the assertions of an interested party.

Now, what happens? I pointed out this circumstance that under this agreement the Admiralty is free to purchase elsewhere any other apparatus except jiggers and jars, and that for these, and these alone, it must still go to the Marconi Co. Mr. Cuthbert Hall has strenuously denied this; still denies it; says that an anonymous correspondent who is a mere man in the street cannot know anything about it; professes that the Admiralty will confirm his denials [they haven't done anything of the sort]. Nevertheless, singularly enough, he has not yet, after writing several long letters to your columns, told your readers of one single piece of apparatus or instrument (other than jiggers and jars) that the Admiralty is not free, so far as that agreement is concerned, to buy elsewhere. He does not even pretend that there is any compulsion in respect of coherers. The Admiralty, if it wants any more coherers, may—*and does*—procure them of other makers than the Marconi Co. Your readers may expect a week hence to find a letter from Mr. Cuthbert Hall denying with his usual gracious urbanity this well-ascertained fact; and he will probably deny it on the

same grounds as before, namely, that the statement is made by a mere man in the street. Such denials are becoming quite interesting ; they are a branch of poetry rather than of science—only the poetry doesn't rhyme.

Now comes the gem of the whole of this correspondence. He has denied up and down, and still denies, even after being confronted with the very words of his own schedule, which names jiggers and jars only. But so soon as I suggest that it is time that the attention of the Admiralty officials should be called to his repudiation of the plain meaning of the agreement, he changes his tune. For on page 136 this is what Mr. Cuthbert Hall now says :—

The Admiralty might have made with our company half-a-dozen contracts since the contract of July, 1905, but if that contract be assumed to govern the situation, it in itself suggests to a person of average intelligence that the schedule originally agreed to may have been extended.

Cautious Mr. Cuthbert Hall. "Might have been made" —"may have been extended." He does not say "have been." No ; he drops from high-strung poetry into mere flaccid prose. Other contracts, indeed ! Well, what answer is this to my point that under *this contract*, the Admiralty is free to buy any apparatus, except jiggers and jars, wherever it pleases ? That is what Mr. Cuthbert Hall has denied. Now that I press him, he hints at *other* contracts : a notable climb down. Well, but, *are there* any other contracts that override this, and bind the Admiralty in respect of other apparatus ? If there are, let Mr. Cuthbert Hall produce them. If he does, then he triumphantly establishes my contention that *this contract* binds the Admiralty's freedom only as to the things named in its schedule—namely, jiggers and jars. If there are not any other contracts, to hint that there may be is empty bluff. It would seem that there are none ; for, returning to the schedule of the official agreement itself, Mr. Cuthbert Hall continues as follows :—

Provision for its extension is clearly made out in Clause 5, Sub-section *c*, which "Your Correspondent" ought to have realised even before he made his alleged reference to the Admiralty. That clause provides for the Admiralty purchasing exclusively from the Marconi Co., the articles mentioned in the schedule *or any other articles which might afterwards be agreed to be treated as included in the schedule*. Other apparatus has been agreed to be treated as included in the schedule, &c.

Clever Mr. Cuthbert Hall. How skilfully he must have laid out the lines to lure the Commissioners for Executing the Office of Lord High Admiral into so neat a trap. Doubtless they thought that they were going to gain complete freedom to purchase where they chose, except as regards the jiggers and jars which they listed so carefully in the schedule of tabooed articles to be bought only of the Marconi Co. And lo ! by this extremely ingenious device they are once more enmeshed ; and so, if only some Admiralty clerk will write on Admiralty paper to say that, of course, coherers, and masts and relays, come under the operation of Clause 5, Sub-section *c*, relating to duplicate parts, why at once, there they are—coherers, masts, relays, and all the rest—virtually inserted in the schedule along with the jiggers and the jars. Even a mere man in the street is lost in admiration at the extreme simplicity and ingenuity of the plan. Everybody must have noticed how active the Marconi Co. has of late been in advertising the spark-coils made in its own manufactory. Happy thought ! Why not get the Admiralty to put spark-coils into the schedule, or treat them as though they were there under sub-Section *c* ? And, presto ! the Admiralty becomes bound to purchase no more spark-coils of Apps, or Newton, or Nalder, or Miller. Admirable ingenuity. After spark-coils, then relays, Morse keys, batteries, all capable of being treated as if in schedule. Wonderful success. Company's shares go up. Incomparable managing director. So simple. Nay, does not the sub-Section *c* itself contemplate this vision of the rosy future ? Here it is, verbatim :—

5. The Commissioners hereby agree with the company—*(c)* That they will not purchase the duplicate parts specified in the schedule hereto [that's the jiggers and trays of Leyden jars, you know] *or any other parts which may hereafter be agreed to be treated as included therein* from any person or persons other than the company, so long as the company are in a position to supply, and do supply the same in a reasonable time after the order is given. If the company shall not be in a position to supply, or shall fail to supply the same within a reasonable time after the order is given, the Commissioners may, without making any further payment themselves, manufacture any such apparatus.

I break off here to comment on the awful spectacle of the Lords Commissioners for Executing the Office of Lord High Admiral *themselves* manufacturing spark-coils, relays, or duplicate parts other than the jiggers and jars "specified in the schedule hereto" ; my Lord Tweedmouth winding the primaries ; Admiral Fisher lacquering the brasses ; Vice-Admiral Sir Charles Drury fitting the terminals ; all under the skilled superintendence of Rear-Admiral Sir Henry Bradwardine Jackson. In other respects, and so far as yet quoted, the sub-section undoubtedly corroborates Mr. Cuthbert Hall's allegation that the clause provides for the Admiralty purchasing exclusively from the Marconi Co. the articles mentioned in the schedule or any other articles [the clause says "parts," not "articles"] which might afterwards be treated as included in the schedule. I agree, it does. And if *that* is what Mr. Cuthbert Hall means when he denies that jiggers and jars, as per schedule hereto, are the sole articles in respect of which the Admiralty is bound, if that—I say—is what Mr. Cuthbert Hall means, then I shall allow him about five seconds before the sword descends. For five seconds are enough to read the remaining words of Section *c* :—

Notwithstanding anything contained in this clause the Commissioners shall at all times be at liberty to obtain from other sources such apparatus used for wireless telegraphy as is not enumerated in the schedule referred to.

Unhappy Mr. Cuthbert Hall ! For the words are quite plain. If the Commissioners are at liberty, they are at liberty. The too-ingenious device, enabling other "parts" to be treated as if within the schedule, turns out not to bind the Admiralty in the least ; for "notwithstanding" anything that it means or may not mean, the Admiralty remains bound only as to the scheduled apparatus—jiggers and jars. And if the Admiralty chooses to use none of the four particular jiggers named in the schedule, but to employ instead Tesla jiggers or Lodge jiggers, and if it chooses to use other condensers instead of the particular trays of Leyden jars specified in the schedule, why should anyone object ? The Admiralty, on the face of the agreement, wanted a free hand—paid dearly for it—has got it. Unhappy Mr. Cuthbert Hall ! To be defeated in one's ambitions is sad : to be defeated on one's special ground of ingenious diplomacy must be doubly galling. To deny one's defeat through thick and thin, and to be exposed by a mere anonymous man in the street is worst of all. But that comes of denying the obvious.

Your Correspondent.

Jerry Wiring.

I have read Mr. S. Fraser's article in your issue of the 25th, where he complains of the way in which some of the wiring of private and business houses is done, and asks who is to blame, the contractor or the engineer ? Surely, in such a case both are ; the engineer mostly, for work not done to his satisfaction ought not to be passed.

We know of late there are very many so-called contractors who know very little about it at all, and this is why the standard of work is in some places going down.

A man now, after he has wired one or two bells and a light, calls himself an electrical engineer or wireman ; he goes on like this for a year or two, and then comes out as a contractor, running it with his other business, whatever it may be, and is only able to get work by cutting the prices, and so has to scamp his jobs to make them pay.

Until this is stopped the bad work will continue, and the standard of work will still go down.

B. R.

Lincoln.

[But this is an old story.—Eds. E.R.]

L.C.C. Stocktaking.—The London County Council tramway stores will be closed during stocktaking as under, and delivery of goods during the periods named must not be made unless specially requested by the chief officer (Mr. A. L. C. Fell). The Leo Street, Old Kent Road, S.E., depôt will be closed from February 1st to February 9th, 1907, inclusive, and the Union Road, Leytonstone, E., from February 21st to February 28th, 1907, inclusive.

THE TRAMWAYS OF THE UNITED KINGDOM.

The annual return which has just been issued relating to tramways and light railways in the United Kingdom shows that during the year 1905-6 (to December, 1905, in the case of companies and March, 1906, for municipalities) the route mileage of electric lines open increased from 1,780 to 1,994 miles (+ 214). The total of all lines was advanced from 2,117 to 2,240 (+ 123). The mileage worked by other than electric traction was further diminished from 337 to 246 (− 91 miles). The number of systems belonging to local authorities increased by 1 and those owned by other parties fell from 146 to 137 through 7 being absorbed into the undertakings of local authorities. It is stated in the prefatory memorandum to the return that local authorities who work as well as own their tramway undertakings have made a *net profit* * of £2,529,752 on the year's traffic, out of which they have applied £663,336 towards the reduction of tramway debt, and £205,981 in relief of rates, while carrying €623,617 to reserve and renewal funds.

Four local authorities and five companies are returned as showing an excess of working expenditure over gross receipts.

	1905-6.	1904-5.
Length of route open	2,239·99 miles	2,116·78 miles
Total number of passengers carried ...	2,236,012,777	2,068,913,226
Capital expenditure per mile of single track open :—		
Lines and works	£12,122	£11,799
All items	£16,195	£15,599
Percentage of net receipts to total capital outlay	6·54	6·36
Ditto to net capital outlay (eliminating amounts expended on construction or purchase of old lines and works now superseded)	7·05	6·80
Percentage of working expenditure to gross receipts	64·23	66·19
Passengers carried per mile of route open	998,226	977,386
Passengers carried per car-mile ...	9·16	9·10
Average fare per passenger	1·10d.	1·10d.
Amount paid in relief of rates out of profits of undertakings worked by local authorities	£205,981	£209,881

From the tables stating the various details concerning receipts, expenses, traffic carried, and so on, we cull the following results—

	Local authorities.	Companies.
Electric cars in stock	6,428	2,848
Number of horses	1,722	8,064
Non-electric cars	257	1,357
Passengers conveyed	1,529,596,438	706,416,339
Car-miles run	154,965,781	89,183,683
Electrical energy used, B. of T. units	231,412,589	84,722,227

OVERHEAD WIRES.

The following memorandum, issued by the Board of Trade under the Electric Lighting Acts for the guidance of applicants for consents for overhead wires, has been sent to us by Mr. Pelham :—

Applications for consent for overhead wires are considered in each case on its merits. The following information should be given :—

1. Where the undertakers are a company, evidence of consent of local authorities, where the wires cross any road.

The local authorities are—

(*a*) In England and Ireland: Borough Councils, Urban District Councils, Rural District Councils.

(*b*) In Scotland: Police Commissioners, Gas Commissioners, Town Councils, County Councils.

2. A statement showing commercial or other considerations why underground cables should not be used.

3. A brief description of the proposed system.

4. Is the supply to form (1) an extension of an existing system of underground cables; or (2) of an existing traction system; or (3) an independent system?

5. A plan on a scale of about 6 in. to the mile, showing the proposed route of the overhead wire. (In the case of Ordnance maps, the sheets to be sent separately.)

6. In the case of high and extra high pressure, plans of construction of poles, &c., on a scale of about 1 in. to the foot.

Note.—Proposals for high or extra high pressure wires carried alongside roads cannot be entertained; the transmission lines must go across open country.

* We refer to this term in our leader pages this week.

PROCEEDINGS OF INSTITUTIONS.

Magnetic Leakage and its Effect in Electrical Design.

By William Cramp, A.M.I.E.E.

(*Abstract of Paper read before the* Institution of Electrical Engineers *at Manchester, January 8th*, 1907.)

Magnetic leakage generally is of two kinds:

1. That which opposes the attainment of the ideal characteristic at which a designer aims in any particular machine (harmful leakage).

2. That which assists the designer to attain the end at which he aims (useful leakage).

I shall commence with harmful leakage in the field systems of continuous-current machines. For a given efficiency, magnetic leakage increases the cost of the machine. In multipolar machines with normal ratios of pole arc: pole pitch (*i.e.*, an average of 0·72) the value for the coefficient varies between 1·5 and 1·15, from 1 to 200 kw. Beyond 200 kw. the coefficient steadily decreases till we reach 1·1 at 1,000 kw. It is evident, then, that beyond 200 kw. the decrease of cost to be obtained by reduction of the dispersion is very small.

Let us take a small size of machine, say 5 kw., and see what improvement can be effected by reducing the leakage. Fig. 1, A, shows the field magnet circuit of a machine having four poles, which

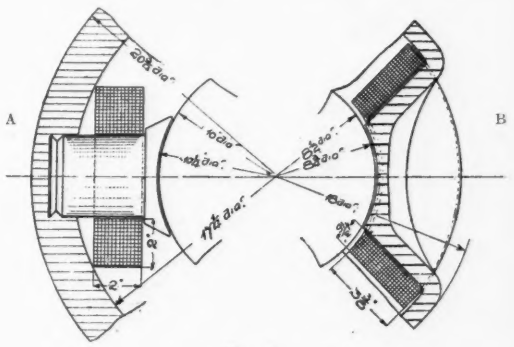


Fig. 1.

I designed some time ago to give 5 kw. at 1,000 r.p.m. The dispersion coefficient is about 1·35. The weight of field copper per spool is 8·22 lb. and its cross-section 2 in. × 2 in.

To reduce the leakage we must either increase the length of the leakage paths or decrease their area.

To apply the remedy of a larger field frame is inadmissible. Examination of fig. 1 shows that the main leakage will take place from pole tip to pole tip. There will be also considerable leakage from pole to pole and from tip to yoke.

Now the leakage path from tip to tip can be reduced by placing the magnetising coil nearer the armature, *i.e.*, around the tip itself, and the area of the path between pole and pole can be reduced by shortening the pole, while the area of the path (and its length) can be changed by bringing the sides of the coils upon the respective poles nearer together.

Thus the ideal machine to reduce magnetic leakage to a minimum would be arranged as in fig. 1, B; but in making the change we have considerably increased the length of mean turn of the field coil, and some method of compensating for this must be introduced if any economy is to be effected.

This compensation, however, is at once seen to be present from the following table:—

TABLE I.

Old machine.	New machine.
a. Cylindrical cooling surface—A.	Cylindrical cooling surface quite 2A.
b. Laminated pole tip to provide and fit.	No pole tip.
c. Pole to machine and cast in.	No machining on pole.
d. Large diameter frame.	Small diameter frame.
e. Commutation good.	Commutation excellent.
f. Leakage factor, large.	Leakage factor, small.

It has been assumed that the field loss remains about constant, while the length of mean turn is increased. Since the resistance must be kept constant if the voltage per coil and ampere-turns are

constant, it follows that a wire of slightly larger diameter is used in the new form.

So then the alteration results in a machine of small diameter costing specifically less, yet with better commutation, slightly larger output, better overload capacity both on account of the commutation and the smaller distortion because of the pole shape.

Keeping the pole area and flux per pole constant, we reduce the armature diameter to 8½ in., and alter its length to 4·7 in. instead of 4 in. The cooling surface is, therefore, almost the same, while the field length of mean turn becomes 26 in. All this is shown in fig. 1, B. Thus a comparison of figs. 1, A and B, yields the following table:—

TABLE II.

	Fig. 1, A.	Fig. 1, B.
Ampere-turns	1,725	1,725
Length of mean turn	17·6 in.	26 in.
Field watts per cent.	2·3	2·3
Yoke diameter	20·75 in.	18 in.
Yoke cost	16·4s.	12·5s.
Field copper cost	36s.	48s.
Total cost (yoke and field copper)	52·4s.	60·5s.
Leakage factor (est.)	1·35	1·1
Output (KW.)	5	6
Shillings per KW.	10·5s.	10·08s.

The costs of the two armatures are the same, so that the cost per KW. is really far more favourable to fig. 1, B, than appears. It is evident that even without considering the reduced cost of machining, fig. 1, B, is the better machine.

These principles should, I think, be applied in machines up to about 20 B.H.P. Beyond this size the ratio of the cost of active material to labour, together with the small decrease of the leakage coefficient, render the advantages to be gained more doubtful.

Advantages can be gained by replacing the four original coils by one of zig-zag shape. That the idea is not new is evident from a perusal of patents No. 7,079 of 1887, and No. 3,970 of 1892. Newer patents are No. 6,666 of 1902, No. 21,202 of 1902, and No. 9,604 of 1903, and they all have for their object what is termed "magnetisation of the armature" as against the usual plan of magnetisation of the field magnet.

If we can show that the length of the mean turn of the single coil is less than the product of half the number of poles and length of mean turn per pole in the ordinary multipolar case, then it will pay to use the single coil, unless indeed it be of such an exceptional shape that the expense of winding it places it out of the question.

So excellent is the commutation produced by field coils which lie midway between the pole tips, while closely enveloping the armature, and so much is the leakage coefficient reduced thereby, that machines far smaller than those of ordinary construction can be built for a given output. There is little doubt that the excellent commutation is in all these cases due to the fact that the position of the field coil renders definite the interpolar field; and an effect can be obtained approaching that produced by special commutating poles. The field shape is not unlike an ordinary slotted stator, with as many slots as poles.

I have found that in certain machines of the bi-polar Lahmeyer type, the nearness of the armature to the yoke, by armature leakage upset the commutation upon overloads. A cure was found for the trouble by fitting from pole to pole in the inter-polar space and quite close to the armature a sheet of copper, this having the effect of considerably reducing the reactance voltage of the machine. It is said that the field coils of single-coil machines possess something of this effect, but I very much doubt it.

With two poles the single coil is never advantageous, and with four and six poles, very rarely. With more than six poles the single coil may pay, but, generally speaking, the machine easiest to wind and most economical is that shown in fig. 1, B.

Having shown that considerable advantages are to be gained by surrounding the armature closely by its field coils, the logical deduction is that if both field and armature coils are placed upon the armature the results will be better still, since any harmful leakage is then converted into useful leakage. This system, of course, would do away with the field coils proper altogether, and would resolve itself into the equivalent of an armature and commutator with the brushes set at an angle to the neutral line, which arrangement in the case of the series motor might be adopted; but in the case of the shunt motor we should need two commutators and two sets of coils, with the "field brushes" at right angles to the "armature brushes."

In order to put these theories to a practical test I have, with the assistance of Mr. Garner, carried out at the Municipal School of Technology a series of experiments upon a bi-polar double-commutator machine.

The results show that only in special cases will such a motor be of commercial value.

In approaching the question of leakage in alternators, I intend to confine myself almost entirely to showing how use may be made of that leakage which must exist.

Already, to some extent, this has been done, as, for instance, in the case of the constant-current alternator; which is so constructed, that beyond certain points every tendency of the current to increase is checked by that increase itself producing (through leakage flux) a voltage in the armature-turns. In ordinary alternators the leakage which exists is of two kinds—viz., field leakage and armature leakage. To the former every word that has been said as to advantage of obviating leakage in continuous current fields strictly applies. The latter sets up what is called armature reactance.

I suggest that armature reactance should in every case be kept as small as possible, while reactance of the armature upon the field should be allowed to cause the latter to leak, and thus produce the constant-current effect.

The same idea may be adopted to cause the alternator to be self-compounding, *i.e.*, it may be used either to cause an excessive fall in volts, or to keep them constant, or to cause them to rise. These principles I first made use of in alternators designed in 1904, and from that date to this I have sent out many successful machines constructed upon these lines.

I call attention to this fact because it appears that only this year (November, 1906) Mr. Alexander Heyland has rediscovered and made use of the same idea. For his method of carrying it out reference may be made to the ELECTRICAL REVIEW of November 23rd, 1906. The method which I employ is specially applicable to alternators of the inductor type, and may be explained as follows:—

Fig. 3 is a section through a special inductor alternator. S is the stator or stationary armature forming also part of the magnetic circuit. R is the rotor, and would carry normally the rotating inductors to produce the necessary variations of flux. A_1, A_2, A_3, are air gaps, and it is evident that if F is the only coil producing the magnetic field, then A_1 and A_2 are magnetically in series, as also are A_1, A_3, whilst A_2 and A_3 are magnetically in parallel with respect to A_1.

Suppose now that the armature coils are wound upon the stator at A_2, while the other two air gaps remain as simple smooth-bore flux paths. If F be excited by a constant current the coils A_2 will generate a certain open-circuit E.M.F. when R rotates at a certain speed, depending upon the relative areas of A_2 and A_3. Directly any current is taken from the coils at A_2, armature reaction is set up which immediately increases the reluctance of the path of the field flux through A_2. In consequence, more of this flux tends to leak by A_3, producing thereby a very large fall of voltage, which will tend to keep the current at A_2 constant. This is particularly the case if the air gap at A_2 be small and the density high with respect to A_3; so that by carefully adjusting the areas of the gaps and the densities, an alternator may be so constructed that only a very small change of current through the coils at A_2 takes place, even if the resistance in circuit with these coils is changed from a large value to short circuit. Complete regulation and control of this effect is obtained if a second field coil be placed in the recess between A_2 and A_3 and connected in parallel with F. A resistance and reversing switch in series with this second coil, will enable all the changes to be produced from an alternator having practically a constant current characteristic to an alternator having the characteristic of a machine intended for ordinary constant-potential supply. If the two field coils are so adjusted as both to tend to make A_1, A_2 the path of their flux, the effect of the second field coil is equivalent to a great reduction of the reluctance at A_3, while when the two are in opposition they both send their flux through A_2, and tend to prevent any possibility of leakage. Thus in either case the armature at A_2 may be wound as if for constant potential. Since the reluctance of each circuit is nearly inversely proportional to the areas of the respective gaps, the calculation for any particular characteristic is extremely simple compared with that required for the ordinary constant-current alternator; and, further, ample adjustment for errors in calculation may easily be provided by means of the second field coil above referred to.

In applying these principles to obtain a machine which shall, with varying currents, give constant potential difference, we should have to provide at A_3 a steadily increasing magneto-motive force of such sense that it would oppose the leakage from F. This is equivalent to compounding in the ordinary way, and in consequence involves a continuous current increasing with the load. In order to compass this and also to make use of the air gap A_3, I have placed on the rotor at A_3 a continuous current armature and commutator, and have broken up A_3 into salient poles.

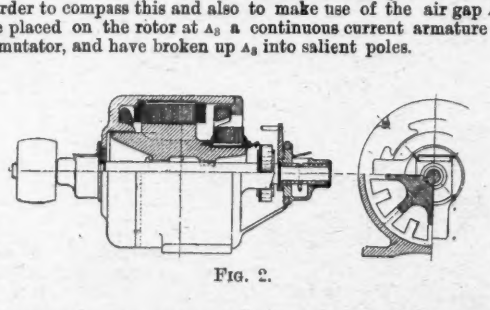


FIG. 2.

The brushes on the commutator being connected through suitable rheostats to the field coil F, we at once have a machine which is self-exciting. Not only this, but the increase of alternating current at A_2, by tending to increase the reluctance of that path, tends also to shunt more flux *viâ* A_3, whereby the voltage at the commutator is increased and with it the exciting current, so that the voltage at A_2 returns to its original value. In this way the machine becomes both *self-exciting* and *self-regulating*; self-regulating not only as regards voltage drop due to increase of current on the alternating side, but also as regards change of power factor involving no change of current. For if the power factor of the A.C. circuit be reduced, the armature reaction at A_2 is increased, which normally causes a fall of P.D., but in this case automatically compounds itself by increasing the exciting current. Moreover, the machine may actually be made so that it over-compounds, the question of the amount of compounding depending simply upon the saturation of the iron paths at A_2 relatively to those of A_3.

Fig. 2 shows a section through an actual machine constructed upon these principles.

It should be pointed out that when constant current is required, instead of reducing the reluctance at A_3, fig. 3, we may if we please

increase the reluctance at A_1. This is very easily carried out if the exciter armature be placed at A_1, for then any increase of current at A_2 increases the reluctance of the whole magnetic circuit sufficiently to drop perceptibly the exciting E.M.F. In this case then, the air-

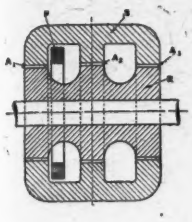


FIG. 3.

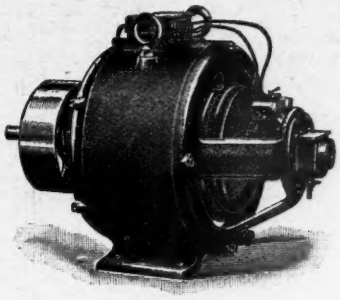


FIG. 4.

gap A_3 is not required, but it may be of use in order to give (by allowing a second field coil between A_2 and A_3) a better magnetic distribution at A_2.

These considerations led to the design of the machine depicted in figs. 4 and 5.

Both these types of machine, figs. 3 and 4, have been made by Messrs. The Crypto Electrical Co., of London; Messrs. Bertram

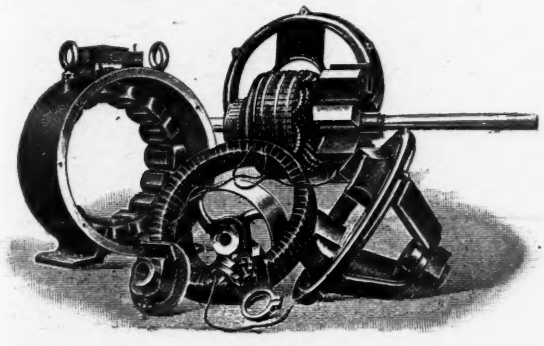


FIG. 5.

Thomas, of Manchester; and Messrs. Brown-Boveri, of Baden, and about 100 are now in use.

Some curves (figs. 6 and 7) showing how the double coil type behaves are given below, but since these machines were intended to have a large fall of potential upon load (*i.e.*, more like constant-current than constant-potential machines), the exciting armature was placed at A_1, and the principal field coil at F. Thus while the characteristic from this point of view is good, the magnetic proportions are wrong if constant potential were desired; so that the curves while illustrating the correctness of the principle do not give at all a fair idea as to how far the construction is practicable. Nevertheless the curves show how large is the range of compensation and it would be a very easy matter to design a constant-potential machine to give still better results. When these machines have been working upon a load possessing considerable capacity, I have seen the exciting watts as low as 30, or about 1 per cent. of the output. It will be observed in fig. 2 that the exciter armature forms rather a large percentage of the total machine. This is partly on account of the fact that, since these machines were constructed to give a falling characteristic, nearly the whole of the flux passes through the exciting armature, and partly because the exciting armature being surrounded by poles which are all of one polarity, different proportions have to be adopted to those which are customary in ordinary D.C. machines. In criticising the use to which these machines may be put, I should be inclined to say that, as constant-current machines self-exciting, the size of the exciter armature would limit their adoption to comparatively small units, but where separate excitation is adopted, there is no limit to the output for which they are suitable.

In considering in the same way the constant-potential type, I should be inclined to think that in such sizes as will entail less than a 2 per cent. loss for excitation, the exciter armature and its magnetic circuit would be too small properly to allow of the regulation being obtained. This, however, needs more practical demonstration. I should like to point out that the *self*-exciting constant-potential characteristic which corresponds very nearly to that of a shunt D.C. machine, is obtained by having two armatures magnetically in parallel; while the constant-current characteristic, which corresponds to the series D.C. machine on heavy loads, is obtained by means of two armatures magnetically in series.

One use further may be suggested for machines of this type—*i.e.*, as a new form of *motor converter*. If in fig. 4 the alternator armature be supplied with an alternating current while the rotor is run up to speed, the machine will run as a synchronous motor because the D.C. armature will excite and set up a field current. When in synchronism, increase of load will tend to strengthen the field magnetism by reducing the reluctance upon the synchronous motor side, so that the machine will automatically compound for fall of voltage upon the D.C. side. Thus we have a motor-converter with its D.C. voltage completely under control and tending to compound automatically, while economy and efficiency are obtained by the use of one field coil for the two armatures.

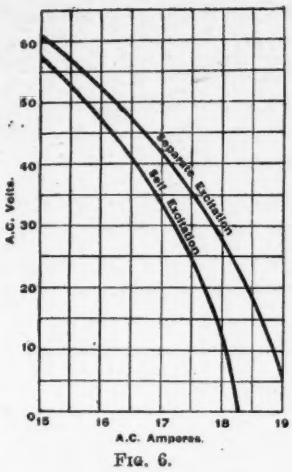


FIG. 6.

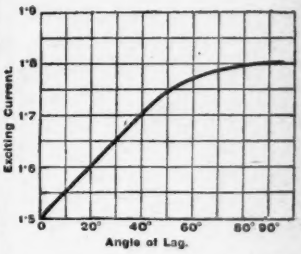


FIG. 7.

In alternating-current motors the great importance of the dispersion or leakage factor in determining the characteristics of the various motors, as exemplified in the semicircle diagram, has led to a great deal of practical research upon the subject, most of which was brought together when Dr. Behn-Eschenberg read his paper upon the subject. The results in the paper referred to give for the most part an excellent approximation for the designer's guide in estimating the leakage factor, and it is only necessary for me here to draw attention to one or two points which appear to some extent to have been overlooked.

The first of these is the fact that no distinction is drawn in the paper between ordinary and hemitropic windings. In my opinion the difference between hemitropic and ordinary reactance per phase is in the proportion of about 5 : 4.

Another point omitted by Dr. Behn-Eschenberg is the effect of "squirrel cage" against "wound" rotors. Naturally for the former v will be less than for the latter, and this change is, I think, about in the proportion of 0·8 : 1.

Harmful leakage in salient-pole alternating-current motors is reduced to a minimum. Useful leakage, on the other hand, has never been made much of. In the starting-up of single-phase motors it has been utilised as, also, it is the principle really involved in the repulsion motor. It can be quite as well employed in that modification of the series motor, which I first suggested at a meeting of this Institution about 12 months ago. It will be remembered that after that meeting my suggestion was much criticised in the electrical Press, one gentleman first stating that such a motor would have low power factor, practically no torque, low efficiency, not really a series characteristic, &c., while afterwards he practically admitted that he did not understand the machine, and asked for a full theoretical explanation.

It was my original intention to give to-night not only a full theoretical explanation, but also a full practical test of such a motor, but unfortunately, owing to the fact that the makers delivered the

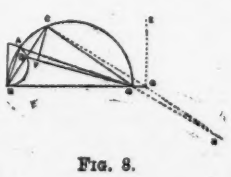


FIG. 8.

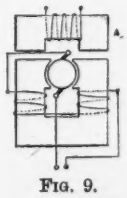


FIG. 9.

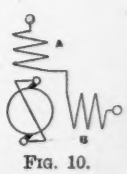


FIG. 10.

machine a month late and with a serious short on it, my test must be delayed for a few weeks. In the meantime I give the theoretical figures and advantages; which is most easily done by commencing with the semicircle diagram for a series motor.

When the armature is locked, a plain series motor behaves exactly as a choking coil, *i.e.*, if in fig. 8, O A represents the locked current for full terminal P.D., then it also represents to a voltage scale the reactance drop in the motor, and A B at right angles to O A represents the resistance drop. O B is therefore the voltage to drive the current O A against the motor impedance, that is the full motor P.D.; whilst O B A is the angle of lag of the machine current behind the applied P.D. Releasing the armature and allowing it to run (still keeping the terminal P.D. constant) we have

an E.M.F. set up in the armature windings practically in phase with the main field flux, but, like the resistance drop, opposing the armature current. This has the effect of reducing the current O A through the addition of an E.M.F. in phase with the armature resistance drop B A. Thus B A is increased to B C, and B C O still remaining a right angle, the current line O A has for its locus a semicircle upon O B as base.

Reduction of O A to O C, of course, proportionally reduces the resistance drop, so that A moves on the semicircle A D B, whilst C traverses the semicircle B C O. Thus for any position C, to the *current scale* (fixed by O A as short-circuit current, A B O as angle of lag given by the wattmeter), O C = current taken. To the *voltage scale* (fixed by O B = full terminal volts) O C = motor reactance drop, B D = motor resistance drop, C O = back E.M.F.

Also since output = back E.M.F. × current, it is = C D × C O, or proportional to the height of the perpendicular from C upon O D, *i.e.*, to C F. The torque is proportional to O C^2.

The above diagram has to be modified in practice to take account of saturation and iron losses, but it is near enough to prove substantially that if (1) The resistance voltage be low (B D), and (2) the back E.M.F. be high (D C) compared with the reactance drop (C O), the motor will be good both as to power factor and efficiency.

(1) and (2) above are easily attained in practice by well-known means. Now if having designed an ordinary series bi-polar motor such as that shown in fig. 9, I apply to its top another limb like fig. 9A, properly wound, and attached to the mains; and if then I join the free end of the present field to the free brush, I shall have a motor whose main and leakage magnetic paths are in parallel *exactly as they are in an ordinary induction motor*; with these differences (1) that in an ordinary induction motor, the torque is produced by the main field and the rotor current, while here it is by leakage field and rotor current; and (2) that in an ordinary induction motor all the B.H.P. has to cross an air gap, whilst here only part need cross it.

These two points are well brought out in the change in the semicircle diagram.

The new primary coil will have a very small resistance, and consequently at constant terminal volts the flux through it will be practically constant, and the magnetising current practically constant also. If the joints in the circuit be good, there is no reason why the magnetising current should be large, and we may draw it as O G, fig. 8; so that the total primary current is now O H (= G C).

The flux across the air gap will now be slightly increased, but also slightly shifted in phase away from O C towards G C, and so the torque still remains practically $\propto$ O C^2. The power factor is changed from cos C B O to cos C G E, and the primary current from C O to C G.

Otherwise the motor remains precisely as before, excepting for the fact that we may wind the high-tension side for any voltage we please, and we may regulate entirely on the low-tension, which windings might be stocked for each size. Also this very change admits of possibilities of improving the slightly reduced power factor, and of immensely improving the commutation by altering the number of armature and leakage limb turns respectively. The armature self-induction is always a problem in H.T. motors, and it is this problem which affects both power factor and commutation.

The self-induction of the armature depends upon (the armature turns per pole)^2, thus a small decrease of the turns produces a large change in the coefficient of self-induction, and hence also a large change in power factor and much easier commutation. Or, to put this matter in another light, these motors may be built with fewer poles than ordinary series motors for the same power factor. There is no difficulty about multipolar designs for this type of machine.

The nearest parallel to the above motor in use at the present day is the repulsion-motor represented diagrammatically in fig. 10. In this motor the short-circuited armature is fed through induction by coils A, while coils B provide the field flux. A and B are placed in series across the mains. When the locked test is applied to such a motor, it is seen that the coil A is relatively non-inductive compared with the coil B, hence a phase displacement of flux takes place, setting up a rotating field somewhat similar to the starting system of an ordinary single-phase induction-motor; and in order to take full advantage of this, a stator without salient poles like that of an ordinary induction-motor must be provided.

We note that in fig. 10 not only has a flux at B to cross the air gap, but also a flux at A, so that the whole energy imparted to the rotor has to cross the air gap. This is the secret of the low power factor obtained with repulsion motors. For the sake of clearness, we may compare four motors with similar characteristics as follows:—

—	Series motor simple.	Series moter with transformers.	Repulsion motor.	Cramp motor.
Suitable to voltage	Low only	Any	Any	Any
Power factor ...	Good	Good	Fair	Good
Commutation ...	Depending on voltage	Good	Only good at sync.	Very good
Iron weight ...	1	1·75	1·1	1·25
Copper weight ...	1	1·75	1·3	1·25
Easy to wind ...	Very	Moderately	No	Very
Compensation coils required	Yes	No	No	No

It is thus seen that for low voltages the simple series motor is best, while for high voltages my motor is best; a verdict which I hope shortly to be able to endorse by definite tests.

Discussion.

Mr. FRITH thought the author wanted to write a paper on things in general, and it was like discussing a number of papers. He did not like the look of the small motor shown, and there was no doubt that for small types they sold more or less by their looks. The method of magnetising from the armature opened out a field of interesting work. The inductor alternator described was interesting, but he thought that type was played out. The "Cramp" motor was very interesting, and he would like to hear more about it, but it might have been explained more simply; it was a series motor with its own transformer set on the top of it.

Mr. C. F. SMITH called attention to the results of one of the tests, for which he furnished an explanation.

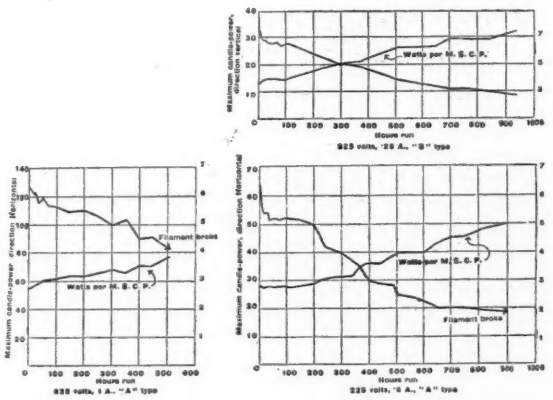
Mr. H. W. WILSON said the dynamos shown were pretty illustrations of machines with less leakage coefficient than the ordinary type; he did not see that the efficiency was higher, but they were a smaller size for a given output. The author had said the motors had a cylindrical air-gap, but he (Mr. Wilson) thought they would have a higher temperature rise, as it was not as well ventilated as the ordinary motor.

Dr. BOWMAN and Mr. GOLDSCHMIDT also spoke.

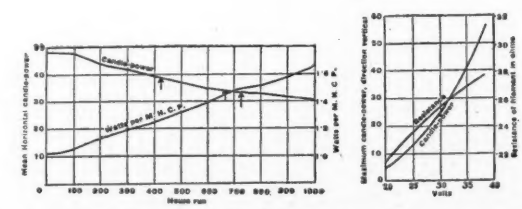
Mr. CRAMP, in reply, fully endorsed Mr. Frith's views as to the necessity of noting carefully the appearance of a motor, but thought there was no reason why the type of machine he suggested should be uglier than any ordinary motor. With regard to Mr. Frith's criticisms on the inductor type of alternator that there was no reason whatever why the same principle should not be adapted to the more ordinary form of machine. With regard to the curves shown, there was a critical frequency at which the machine behaved best. In considering that the new alternating-current motor shown was essentially the same as a series motor with separate transformer, Mr. Frith was quite in error, for the economy obtained by the latter combination was very marked both in copper and iron, as shown by the table of comparison given in the paper.

New Incandescent Lamps.

IN our last week's issue we referred to some interesting tests carried out by Mr. Clifford C. Paterson, of the National Physical Laboratory, the results of which were communicated by him in the discus-ion on Mr. Jas. Swinburne's paper. The curves here given, embody the results of the tests in question. Mr. Paterson, to whom we are-indebted in this connection, remarked that the results were probably average performances. He had tabulated the average figures of some of the smaller lamps as follows:—



TEST ON SIX NERNST LAMPS: SHOWING FALL IN C.P. ON LIFE TEST.

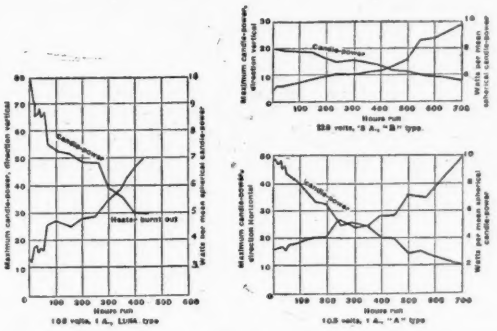


(Arrow-heads denote broken filaments.)

TEST ON SIX 37-VOLT, 48-C.P. ZIRCON LAMPS: VARIATION IN C.P. AND EFFICIENCY ON 500-HOUR RUN.

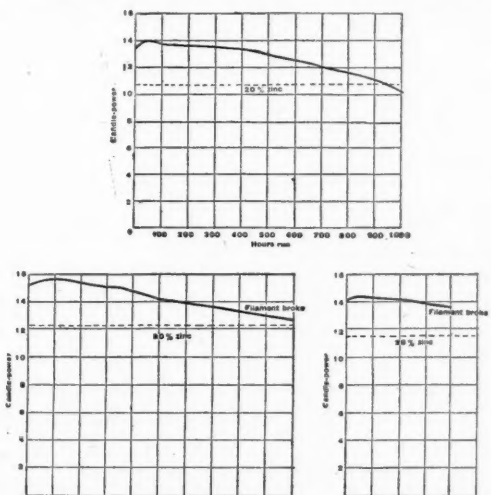
Lamp.	Volts.	Initial c.p.	Initial efficiency.	Total watts.	Per cent. c.p. drop after 1,000 hrs.
Nernst	200	25 M. Hem.-Sp.	2·2	56	70
Metallised carbon	100	16 M. Hor.	2·8	45	20
Tantalum	110	23 ,,	1·9	44	35
Zircon (early lamp)	37	48 ,,	1·0	50	37
Osram	100	25 ,,	1·4	35	—
Ordinary carbon...	100	16 ,,	3·6	57	20
Ordinary carbon ...	200	16 ,,	4·3	69	20

The Nernst lamp, although it had a large drop in c.p. with age, was the only one of the new lamps which would run on 200 volts;



Test on Six Nernst Lamps; Showing Fall in C.P. on Life Test.

and the Zircon lamp had been much improved lately. The total watts column read in conjunction with the candle-powers showed that the power taken by the various lamps was nearly of the same



Life-Test on 100-Volt Matallised Filament Lamps, at 2·8 Watts per Candle.

order of magnitude. It was also noticeable that the c.p. of the metal filament lamp only varied as the 3·5 power of the voltage, as against the fifth or sixth power of the carbon filament lamp.

LEGAL.

Robert Cort & Son *v.* Holford.

In this case, which was heard by the Common Sergeant (by consent without a jury) in the Mayor's Court, on January 25th and 26th, the plaintiffs sought to recover a sum of £18 17s. 2d., for balance due upon an account rendered for goods supplied and work done by the plaintiffs as engineers for, and on behalf, of the defendant at his request, in and during 1906. The defence was a denial of liability, and in the alternative, (*a*) that the claim was partly for extras for which the defendant was not liable under the contract; and (*b*) for the price of certain electrical fittings purchased from the General Electric Co., in respect of which the defendant said he was entitled to the trade commission. There was also a counterclaim for expenses alleged to have been incurred owing to the fact that a dynamo supplied was not of first class quality.

Mr. W. Valentine Ball appeared for the plaintiffs; Mr. C. B. Marriott for the defendant.

It appeared that early in 1906 the defendant was having his house at Poona Lawn, Nazing, Essex, wired for electric light. The wiring was being done by the plaintiffs as sub-contractors to another firm. On February 12th the defendant, being dissatisfied with the contractor, made inquiry of Mr. R. Percy Sims, a member of the plaintiff firm, asking him to tender for the erection of the plant. According to the plaintiffs' case he was asked to quote for an installation which could be worked by a 3-h.p. engine, which the defendant had in his stable. No particulars were given as to the engine, and according to the plaintiffs nothing was said as to extras. The defendant, on the other hand, alleged that he expressly stated it was, to be a "lock, stock and barrel" contract with no extras of any kind. On the following day the plaintiffs wrote to the defendant giving an estimate for fitting up the installation, setting out certain items amounting in all to £146 16s. On the same day the defendant virtually accepted this estimate, subject to the qualification that he would require a battery capable of lighting a larger number of lamps. Consequently the plaintiffs were compelled to charge an extra £10 5s. for additional cells to be ordered from the Hart Accumulator Co. The whole plant was to be ready for working by February 24th. According to the estimate the dynamo was to be capable of producing 25 amperes 70 volts at 700 revs. The plaintiffs found that such a dynamo was not immediately procurable, and they therefore suggested to the plaintiffs that he should have another dynamo capable of producing the same current at 840 revs. To this the defendant assented, on the ground, as he said, that he was relying on the plaintiffs' judgment. According to the plaintiffs' case the engine was found to be insufficiently powerful for the installation, and when an attempt was made to charge the battery it was found impossible to get the engine to run at a sufficiently high speed. The plaintiffs then provided a resistance (for which they charged £1 5s.) and an automatic cut-out, for which they charged £6.) It was then found possible to charge the cells. After this, repeated complaints were made by the defendant that the installation was not working properly, the plaintiffs continuing to allege that the fault was due to the engine. In April the defendant consulted two electrical engineers, and asked them to inspect the plant. They were of the opinion that the irregularity in working was due to the absence of a suitable resistance. The plaintiffs also had the plant examined by a representative of Messrs. Parker, of Wolverhampton, who reported that the fault lay with the engine. In the following month the plaintiffs sent down a new resistance; but it was not made clear that this resistance was sent at the request of the defendant; in fact, the plaintiffs said that it was sent by them upon their own initiative and that it was not charged for. The defendant admitted that in the month of May he sent the engine to Messrs. Petter to be overhauled, and that some repairs were made to it. He contended, however, that the plant never worked really satisfactorily until the new resistance was supplied by the plaintiffs. With regard to that part of the plaintiffs' claim which related to fittings, the plaintiffs said that they were supplied by the General Electric Co. through them, and that they were entitled to the trade discount. The defendant, on the other hand, stated that Mr. Sims had agreed that he should order the fittings from the General Electric Co. and charge the defendant what they cost.

A large body of evidence to the above effect having been called on either side, the case was adjourned *sine die*.

Bellamy *v.* Wakefield and District Light Railway Co.

In the Chancery Division of the High Court on Friday, Mr. Justice Joyce had before him a motion by Joseph Bellamy, manufacturing confectioner, of Wheldale Mills, Castleford, to restrain the Wakefield and District Light Railway Co. from committing a nuisance by emitting smoke of petrol from their electric power station at Castleford.

Mr. Owen Thompson, for the plaintiff, said the defendants desired the case to stand over for a week, in order that they might consider further affidavits. The nuisance was a very serious one, and he asked that something might be done to mitigate it in the meantime.

His Lordship: If they do not do so it will be worse for them.

Mr. Younger, K.C., for the defendants, undertook to communicate with his clients. He hoped they would be able to make things right. Everything would be done to remove any inconvenience suffered by the plaintiff.

Mr. Thompson said it was not only the plaintiff who was suffering. The plaintiff employed 75 workmen, and their health was being seriously affected; the petrol smoke being emitted was like a blue fog. (Laughter.)

His Lordship: Then you will be able to take a photograph of it. (Renewed laughter.)

The motion, it was afterwards directed, should stand over for a week.

Bergtheil & Young *v.* R. N. Cunningham & Co.

In the Lord Mayor's Court, on January 23rd, before the Common Sergeant and a jury, plaintiffs sued defendants for £11 10s., principal and interest on a dishonoured cheque. In a report appearing in the *City Press* it is stated that in January last the defendants purchased a job lot of electric fittings of the defendants, and the cheque sued upon was given in payment. A question arose as to whether a certain bronze figure was included in the goods.

The defendants said that in consequence of a telephone message from the plaintiffs the figure was not included, it was verbally agreed that the sale should be rescinded and the goods returned. On January 27th they sent the goods back and stopped payment of the cheque. The plaintiffs at first denied that the figure was included in the sale, but they afterwards admitted that that was a mistake. They denied that they had agreed to a recission of the contract. Accordingly they refused to take back the goods. The defendants counterclaimed for £6 10s. warehousing charges. It may be remembered that the matter had already been before the Recorder of London, and the defendants appealed to the High Court, and a new trial was allowed. The jury now found a verdict for the defendants on the claim, and also on the counterclaim for £1 10s., with costs of both trials and the appeal.

Claim Against the Midland Railway.

The efficacy of the electric lighting system on the fleet of the Midland Railway Co. which connects Heysham with Belfast, was called in question in a case at Lancaster Assizes on Saturday and Monday. John Wm. Potter, builder and joiner, Norton and Stockton-on-Tees, sued the Midland Co. for £152 damages for injuries received during a voyage from Heysham to Belfast on May 2nd, 1906. He alleged that owing to insufficient lighting he fell down a well-hole from the steerage to the cattle deck, sustaining a fracture of the base of the skull, and injuries to the left ear, which had partially disabled him from following his occupation. The defence was that the vessel was splendidly lighted, the best on the channel service, and Mr. W. J. Instan, electrical engineer to the Midland Railway Co., Heysham, stated that he personally inspected the lighting arrangements before the vessel left the quay. A further defence was that the plaintiff was guilty of contributory negligence in not looking where he was going.

The jury found for the defendant company, judgment being entered for them, with costs.

Hiscock *v.* Irwin and Neal.

In the Wandsworth County Court, on Monday, this remitted action from the High Courts, came on for hearing. Plaintiff, who is an electrical engineer, claimed £76, balance of an account totalling to £150, for the installation of electric light and bells at a building at Neal's Corner, Hounslow, belonging to Mr. Neal, and erected by Mr. Irwin a contractor.

Plaintiff stated that in June, 1904, he was invited by an architect, named Mr. Davies, who was working for the defendants, to tender for the electrical fittings required. He tendered, and on June 27th, 1904, he received a letter from Mr. Davies asking him to do the work. He proceeded with the installation, and in September of the same year received a cheque for £75 on account from Mr. Irwin. He completed the work on January 27th, 1906, and sent in an account amounting to £155 6s. 3d. Mr. Davies checked this account and reduced it to £150 1s. 9d. As he had received £75 on account the amount still due to him was £75 1s. 9d.

In cross-examination plaintiff said that each defendant swore the other was liable. At the time he took the contract he did not know who was responsible.

Mr. William Augustus Davies, the architect, said he invited plaintiff to tender on Mr. Neal's behalf.

The defendant Neal said, until a writ was issued in this action, he never had any application from Mr. Hiscock to pay this amount. This £150 was in the specifications as one of the provisional sums. In this case Mr. Irwin was suing him for a balance, and he had a very heavy counterclaim for some hundreds of pounds.

Counsel: Who is liable to the plaintiff?—Irwin is liable for everything.

Mr. Irwin, the other defendant, said the sum of £150 was set aside in the contract for electric wiring.

Counsel: For electric work?—Electric wiring, not work. It was distinctly stated in the contract "electric wiring."

Then you admit liability for the wiring done by the plaintiff?—Oh, yes.

His Honour said apparently it was his duty to say which defendant was liable to the plaintiff. To his mind it was perfectly clear that Mr. Neal was responsible. He was undoubtedly legally liable, and he gave the plaintiff judgment against him with costs. He dismissed the defendant Irwin from the action, and ordered the plaintiff to pay his costs, giving plaintiff the option of adding what he paid to Irwin to his bill of costs against Neal. He granted a 10 days' stay of execution.

Deep Leads Electric Transmission Co., Ltd.

The petition for the compulsory winding up of this company came before Mr. Justice Parker on Tuesday, when an application was made on behalf of the petitioners for a further adjournment. They had filed their evidence some time in October last, and the matter had stood over since then, because negotiations had been taking place between the different parties. Part of the respondent's evidence had been received on the previous night, with an intimation that more would be filed in the course of a day or two. The prospects of an arrangement seemed to have broken down for the time being, and they were anxious to file the evidence now, in order to be prepared to bring it before the Court in a fortnight.

Mr. Gore Brown, K.C., said there were three parties to the negotiations. The petitioner and the company got along pretty well, but the third party caused the difficulty. It was desired that the evidence should go on meanwhile, but it was eminently desirable that it should be settled, and the negotiations would continue.

His Lordship granted a fortnight's adjournment, and hoped the evidence would then be ready.

BUSINESS NOTES.

Book Notices.—*How to Avoid Payment of Debt.* By A Solicitor. London: Simpkin, Marshall, Hamilton, Kent & Co., Ltd. 1s. net.—This title might be described as an attempt on the part of the author to allure the dishonest—the "don't-intend-to-pay" class—into a trap preliminary to administering a sound thrashing (if the offender will but remain there long enough to receive it). But the title also catches the attention and arouses the interest of that vast multitude who, to their humiliation and remorse, are the victims of those parasites who know how to dodge clear of the long arm of the law. The author shows in an interesting way, yet one which stirs up one's righteous indignation, how utterly impossible it is to make a man pay if he has made up his mind that he will not do so. The creditor is in such a case hedged round by difficulties. The writer sets out certain suggestions as to remedial measures after obtaining judgment, and improvements in County Court procedure. It is the extremely unsatisfactory position in which the creditor at present stands that the author has endeavoured to make plain in this little book, in the hope that by the dissemination of such knowledge the public will be roused to agitate for reforms to be seriously taken in hand. Much that is written in the book is, of course, already known to many business men from unfortunate experience, but there are large numbers of our readers who would find it profitable to scan these 98 small pages of plain, bold type. It may make them more on the alert in some of their future transactions with men who may be unworthy of their confidence; and it may make them resigned to write off certain past bad debts as beyond recovery.

The "Electrician" Wireman's, Linesman's and Mains Superintendent's Pocket Book. By F. C. Raphael. New Edition. London: The *Electrician* Printing and Publishing Co., Ltd. 1906-7. Price 5s. net.—The first edition of this handbook made a favourable impression upon us, which was reflected in our notice. Naturally, the new issue, which is an improvement upon its forerunner, can do no other than add to that impression and lead us to indite fresh encomiums. The book has been revised throughout and partly rewritten, and the matter has been brought up to date as nearly as possible. Mr. H. M. Sayers has contributed a new section on electric tramways. The connections of motors—both direct and alternating current—are dealt with fairly fully; there is room, however, for further extension here, as this is one of the points on which information is often wanted and seldom available, and there are many useful arrangements not included. The rapidly increasing use of motors lends importance to this matter. Under "twin lead-covered wiring" the use of vulcanised rubber insulated wires should certainly be found. We should like to see the principles governing the correct use of fuses briefly explained on p. 59. The illustration on p. 177 of a prepayment meter is, in our copy, almost "illegible." The excellent article by Mr. Justus Eck, on the preparation of estimates for house-wiring, and on the method of submitting an estimate, deserves commendation. Arc lighting (which is somewhat scattered in the book) is not dealt with on p. 212, as stated in the index. The illustration of cells in parallel (fig. 200, p. 363) shows them also in series, and therefore short-circuited. Summing up, we like this book, not only for its excellent contents, but also for its very handy shape and opening, and we confidently recommend it to those for whom, as the title implies, it is written. Indeed, hardly anyone would fail to find it useful.

Electricity of To-day: Its Work and its Mysteries. By C. R. Gibson, A.I.E.E. London: Seeley & Co. 1907. Price 5s. net.—This is a non-technical work, by the author of "The Romance of Modern Electricity," but unlike many popular treatises of this kind, it has been carefully read in proof by technical experts, and may therefore be expected to put forward reasonably correct statements and opinions. So far as we have been able to check it, this anticipation has been verified. Not only is the descriptive matter very clear and sufficiently accurate, without being pedantic, but also the illustrations are well chosen and up-to-date. Starting with a simple introductory chapter the author develops the idea of electro-magnetic phenomena, upon which electrical engineering is really dependent in almost every practical application, and arrives at electric traction in Chapter III, while the two following chapters deal with a large tramway undertaking (Glasgow), and with railways. Electric lighting, heating and cooking, electro-chemistry, meteorology, telegraphy and telephony, electro-therapeutics, electrical measurements and theory, are amongst other headings dealt with, and the whole forms a very interesting and praiseworthy summary of the subject suggested by the title of the book.

American Trade Index, 1906.—This is the eighth annual issue of the English edition of this handbook, which is a descriptive and classified membership directory of the National Association of Manufacturers of the United States. The publication is issued for

the information of foreign buyers; indeed, as the introductory notice says:—It is "designed to acquaint the business man abroad with a channel through which he may obtain trustworthy information about American products and producers." The Association is the said channel, and it is prepared to furnish business men in any country with information on subjects tending to promote international trade. A large staff is engaged at the offices of the Association, in New York City, for fulfilling these objects and others of interest to its members, and we have no doubt that this is a piece of American enterprise that has been fully justified by the results obtained. Does such an organisation as this exist in this country for pushing the interests of British manufactures in foreign countries! If not, is there not room? When we grumble at the inefficiency of our consular service commercially, it might be as well to remember that American manufacturers who, according to reports, are better looked after in that respect, do not depend too much upon that assistance, but have organisations of their own feeling out the way for foreign trading.

Business Prospects Year Book, 1907. Edited by Joseph Davies and C. P. Hailey. London: *Commercial Intelligence* Publishing Co., Ltd. 2s. 6d.—During the past few weeks everybody has been reading with more or less interest newspaper and other articles summarising the course of different departments of science, trade and industry during the year 1906. In most cases one has become accustomed to these articles concluding with guarded predictions as to what, in the ordinary course of events, may be expected to happen during the new year. It does not do to pin too much faith to these predictions in a general way, for, sure enough, the "ordinary course of events" will be departed from. In this book the compilers have been bolder than the usual run of Press prophets, for the whole of the 150 odd pages are devoted to forecasts—"expert predictions of the probable course of business in each of the principal branches of trade"—but they base their predictions upon the lessons that are to be learnt from the commercial records of past years, considered in connection with such current facts as are obtainable. Coal, copper, iron, tin, shipping, the money market, stocks and shares, cotton, timber, wheat, petroleum, tin plates, &c., are each dealt with in separate sections. The book is useful on account of the facts that it sets out concerning the course that these trades and their ruling prices have taken over a good many years, but having thus indicated the general nature of the contents, we leave it to the reader to judge for himself whether he will find it of practical assistance in making his business plans, or only of interest as a trade study. It is pointed out that the book is distinctly not a commercial "Old Moore," for its predictions are founded on a strictly scientific basis, and there is no guesswork about it.

Advertising That Tells. By George Carl Mares. London: Guilbert Pitman. 1s. 6d. net.—The sub-title of this book is "How to Advertise in a Small Way Successfully." In these days it is imperative to advertise continuously and in attractively up-to-date style in order to secure the best results. This is a handy-sized book on the subject that the publicity man or the advertisement designer can carry in the pocket and read in the train. It will tell those engaged in this increasingly important department of trade service many things that they ought to know—things which, when known, would lead to the advertisements in some papers (perhaps we might even say the technical journals) being made far more interesting and profitable to all concerned than they are likely to be if the advertiser keeps to the old ruts. The book before us gives information concerning different styles of printing types, wood, photo-engraving and line-block production, the preparation of booklets for postal circulation, &c.

Electrons, or the Nature and Properties of Negative Electricity. By Sir Oliver Lodge. London: Geo. Bell & Sons. 1906. 6s. net.

"Fourteenth Annual Year-Book (1906-7) of the Armour Institute of Technology, together with Prospectus of Courses Offered." Chicago: The Institute.

"Proceedings of the American Institute of Electrical Engineers." Vol. XXV, No. 12, December, 1906. New York: The Institute.

"L'Année Electrique." By Dr. Foveau de Courmelles. Seventh year. Paris: Ch. Béranger. 1907. Price 3.50 fr.

"Fortschritte der Elektrotechnik." Vol. 20, Part I. Berlin: Julius Springer.

"Elements of Electric Traction for Motormen and Others." By L. W. Gant. London and New York: Harper & Bros. 1907. Price 5s. net.

"Electric Ignition for Motor Vehicles." By W. Hibbert. London: Whittaker & Co. 1907. Price 1s. 6d. net.

It is announced that Mr. Werner Laurie is about to publish a novel by Mr. Arthur Stringer, a young Canadian, entitled "The Wire Tappers."

"The Engineering Index." Vol. IV—Five years, 1901-1905. London: The *Engineering Magazine*. 1906. Price 30s. net.

Automobile Show at Prague.—The Third International Exhibition of Automobiles at Prague will be held at the Industrial Palace, from March 24th to April 1st, 1907. It will comprise automobiles of all classes. Applications concerning space, &c., should be addressed to the Committee of the International Exhibition of Automobiles, Wenzeloplatz, 13, Prague.

Water Purifiers.—The Haste Pump Co., Ltd., has received a contract from the War Office for a water purifier to deal with 80,000 lb. of boiler feed-water per hour, for Woolwich Arsenal; and a further order for an automatic self-flushing filter from Messrs. Davis-Perrett, Ltd., for the Westminster Electric Supply Corporation, Ltd.

France.—La Société Electro-Métallurgique du Sud Est is the name of a company which has just been formed at Lyons with a capital of £184,000.

Catalogues and Lists.—Messrs. Dorman & Smith, Salford.—The firm are about to issue a fuse section (No. 69) of their catalogue; they have specialised somewhat in this department, and are now in a position to supply from stock almost any requirement in the way of fuses for circuits up to 500 volts. An advance copy of the list is to hand, and it covers several types of which the firm are patentees. There are descriptions of asbestos-covered fuses, baffle type, branch, circular blow-out, house service, iron-cased, thumb type, well type and many other types of fuses. All are finely illustrated with half-tone and diagrammatic blocks printed on art paper. Prices and other figures are arranged in table form.

Messrs. Davidson & Co., Ltd., Belfast.—Well illustrated 16-page pamphlet (Bulletin No. 2,009), containing a description of their Sirocco dust fans. A number of half-tone blocks show views of a textile mill, emery dust removal plant and a hair teasing machine, in connection with which these fans are used. Diagrams of standard types, and tables of outputs and dimensions, are included.

The Brooke Tool Manufacturing Co., Ltd., Belgrave Road, Birmingham.—Leaflets relating to their machine-relieved gear cutters (involute form) for teeth or gear wheels. These are made in both best cast-steel, and the company's special high-speed steel, and prices of both are given side by side. The company have for nearly a year past been working day and night on small tools only, for the War Office, Admiralty and leading firms, largely on repeat orders. They are now making the shallow or stub form of tooth for motor-car gears, electric crane gears, and other quick-running machinery, which is claimed to run much more smoothly than the usual depth of tooth.

The *Brush Budget*, issued by the Brush Electrical Engineering Co., Ltd., has a frontispiece which ought to appeal to the heart of every electrical engineer. The inside contents are of more technical interest, describing respectively electricity in service in the Hatton Garden metal-working factory of Messrs. Johnson, Matthey & Co., where Brush motors aggregating 300 H.P. are in service; a Glasgow carpet factory electrically equipped; pictures of tramway and rolling stock; and a view of the Bermondsey electricity works, where a 500-KW. Brush set has just been installed. The Brush Co., are sending out to such of their friends as desire it a date-block "Poetical Calendar," with daily quotations from the works of Longfellow.

The Armorduct Manufacturing Co., Ltd., London, E.C.—20-page publication, in which there is printed a copy of a report of the Westminster Electric Testing Laboratory on bending tests made by them of 1-in. welded and screwed conduit with special reference to the behaviour of the enamel used. Five other makes were also tested, and the result is stated, much to the advantage of Armorduct. Half-tone views appear of a number of public buildings which are wired on the Armorduct system.

Union Electric Co., Ltd., London, S.E.—New list No. 1,302, illustrating and pricing their open-type pure carbon arc lamps for D.C. The F, O and O S patterns of lamps are dealt with. Several modifications in these patterns have been introduced in order to bring them more into harmony with customers' requirements. These modifications include (*a*) the drop arrangement for pattern F, for ascertaining whether the feed mechanism is in perfect order, without the use of electric current; (*b*) the hanging pattern of resistance over the O S pattern lamp; (*c*) the outdoor hanging pattern of compensating line resistance; (*d*) the finish of the O lamp as patterns 62 and 63, for very small currents ranging from 3 to 8 amperes.

Messrs. Blackstone & Co., Ltd., Stamford.—24-page pocket-size catalogue containing full description of their "Blackstone" oil engines, their system of working and construction. Capital small half-tone pictures appear of these engines with oil-tank foundation and with independent oil-tank, also of double-cylinder engines, portable type, automatic starters, a new direct-acting centrifugal governor, and combined oil engines and pumps. It may be added that the firm have just taken London offices and showrooms at 81, Cannon Street, E.C., and 4, Budge Row, E.C., where these engines and other specialities of the firm will be on exhibition. Mr. W. A. Simper, A.M.I.M.E., has been appointed London agent.

New Zealand.—The New Zealand Customs authorities have recently given a decision to the effect that electric fans are to be classified as "blowers," and admitted into the Colony free of import duty.

Electric Signs.—Although it is not long since we announced that the General Electric Sign and Engineering Co., Ltd., had commenced business, we understand that they have already obtained very considerable orders for their goods in Germany and France. Last week large orders were received from both countries, showing that these British-made Ge Se signs are favoured on the Continent. The company's great speciality is the manufacture of flash apparatus and flash signs.

Fan Note-Filing System.—Mr. G. Dunkerley, of 18, Claremont Avenue, New Malden, has improved upon the original pocket filing system mentioned in our issue of November 30th last, and sends us a sample set of cards provided with neat covers. We note that a patent has been applied for. Prices and particulars can be obtained from the inventor.

Bankruptcy Proceedings.—F. E. Williams, electrical engineer, 328, Coventry Road, Birmingham (trading as F. E. Williams & Co.).—A receiving order was made on January 23rd, at Birmingham Court, on a creditor's petition.

R. O. Thompson, electrical engineer, Freshfield Road, Brighton.—February 12th is the last day for proofs for intended dividend to be sent to Mr. E. W. J. Savill, 4, Pavilion Buildings, Brighton, the Official Receiver.

Trade Announcements.—The Allgemeine Elektricitats-Gesellschaft (A.E.G. Foreign Department), announce that from to-day their address will be 605-6, Caxton House, Westminster, S.W. All communications concerning foreign and export business should be addressed there.

Messrs. Morris & Lister, electrical engineers, has recently equipped the Carlton Works, Lockhurst Lane, Coventry, with modern machinery and tools, and are now manufacturing switchboards and electric controlling gear generally. They are putting on the market new lines of power switches, fuses and cut-outs, and are also specialising in iron-cased switchgear. Lists of standard sizes of these and other specialities are in course of preparation. Messrs. Frampton & Paine, of 29, Old Queen Street, Westminster, S.W., have been appointed sole selling representatives for London and the South of England.

Messrs. Frampton & Paine have discontinued their connection with Messrs. Lionel Robinson & Co., Ltd., of Ferry Works, Thames Ditton.

The Sheffield-Simplex Motor Works, Ltd., have now removed to their new works, and all letters should therefore be addressed to them at Tinsley, Sheffield.

The Hart Manufacturing Co. are removing, on February 5th, to larger offices and store rooms at Belgrave Chambers, 72, Victoria Street, S.W., where they will carry the larger stocks necessitated by increased business.

Dissolutions and Liquidations.—The British Uralite Co., Ltd.—This company is winding up voluntarily, with Mr. R. L. McLaren as liquidator.

Lionel Robinson & Co, Ltd.—At a meeting held on January 24th, liquidation was resolved upon, with Mr. H. J. Page, 21, Ironmonger Lane, E.C., as liquidator.

Electroid, Ltd.—A meeting is to be held at 31, Budge Row, E.C., on February 26th, to hear an account of the winding up from the liquidator (Mr. F. L. Jenkins).

Foster & Co., electrical engineers and arc lamp manufacturers, Worple Road, Wimbledon.—Messrs. C. E. Foster, E. R. Grote and M. V. Ely have dissolved partnership. Debts, &c., will be attended to by Messrs. Grote & Ely, who will continue the business under the old style at the same address.

Leslie Walker Instantaneous Fire Detector and Fire Indicator Co., Ltd., 34, Hatton Garden, W.C.—A second and final dividend of 10s. in the £ is payable by the Official Receiver at 33, Carey Street, W.C.

LIGHTING and POWER NOTES.

Bristol.—At a recent L.G.B. inquiry held in Bristol with regard to a loan for electrical extensions, it was laid down by the Inspector that the wages of permanent workmen must not form part of the expenditure included in a loan. It was not suggested that any of the remuneration of staff officials should be included, but it was argued that the mere fact that a regular Corporation workman was engaged on work involving capital outlay ought not to bar his wages being included in the loan. To comply with this L.G.B. requirement, it was necessary to employ no permanent staff, but to simply engage men as required. Since then Mr. John Burns has received a deputation of municipal engineers, Mr. Yabbicom, the city engineer of Bristol, being one. Mr. Yabbicom explained to the President of the L.G.B. that recent loans had been reduced by sums representing the wages of workmen held to be permanently employed. The practice in Bristol was to engage only the minimum number of workmen necessary for ordinary requirements, and when exceptional works were carried out, additional men had to be employed. In order to get the best results, it was necessary to mix experienced hands with the casuals. In electrical work, it was absolutely necessary for safety that the jointing of the cables and the work in the transformer chambers should be carried out by skilled men. Yet the Inspector of the L.G.B. objected to the wages of these experienced men being introduced into the loans. The same difficulty touched other departments of civic works. Mr. Burns, in reply to the deputation, said it was the policy of the Board to encourage in every way the employment of direct labour by local authorities, but he looked with disfavour upon the practice of transferring men from permanent to other works. If a certain number of men were necessary and sufficient for every-day work, and some of these were taken off for other work, it implied either that the ordinary staff was greater than it should be, or the routine work would suffer in consequence. He considered that the wages of no permanent foreman should be embraced in loans, but allowed that the question of employing a certain number of leading hands was one for consideration. The L.G.B. would shortly issue a memorandum to local authorities on the subject.

Blackpool.—The T.C. has decided to supply current to lighting consumers for heating at 1d. per unit, and for lighting outside the lighting peak load hours—4 p.m. to 9 p.m. in winter, and 6 p.m. to 10 p.m. in summer, at 1d. per unit, and at 6d. during the above exclusive hours.

Bury.—We learn that the electrical engineer has been instructed to obtain tenders for another 500-kw. set and boiler.

Cleveland.—A Darlington paper says that the power house at Grangetown belonging to the Cleveland and South Durham Electric Co. is near completion; in fact, a start has been made by supplying a Stockton ironworks with electricity for power purposes. Three turbine sets of 1,200 kw. each have been installed, and mains are being laid at Haverton Hill and Billingham, and posts are being put up in Cleveland, so as to reach the ironstone mines.

Continental Notes. — Germany. — The municipal authorities of M. Gladbach have voted a sum of £60,000 for the establishment of a central electric lighting station in the town.

Coventry.—The City Council E.L. Sub-Committee has reported that it has considered the proposal made by the Leicestershire and Warwickshire Electric Power Co., to supply electricity in bulk to the Corporation, and recommends that no action be taken in the matter at present. An outline scheme prepared by the manager for comprehensive extensions at the electricity works was submitted, and it was decided that the Sub-Committee be authorised to select an expert and to submit the scheme to him for his advice.

Crompton.—The U.D.C. has decided to apply to the B. of T. for an extension of the E.L. order.

Durham Collieries.—Considerable developments are taking place in the use of electrical power among the collieries of Durham county. Following the Lambton electrification, the Hetton Collieries are also installing plant for the working of the pits. Developments are also taking place at the Woodhouse Colliery of Messrs. Sadler & Co., which has been re-opened after a long spell of inactivity, and two electrical coal-cutting machines have been installed. Three other machines will be added shortly, and operations will be extended to districts which have not been mined for some time.

Erith.—The U.D.C. has received sanction for a loan of £1,275 for electrical purposes.

India.—From *Indian Engineering* we gather that arrangements are shortly to be made to light Mysore city by electricity, and that the Municipal Board has agreed to pay R. 10,000 per annum towards the cost.

The East Indian Railway, having found the present electric plant at its Jamalpur shops insufficient for the entire driving by electricity, arrangements are being made to obtain 16 additional motors at a cost of about R. 41,000.

It was advertised in an Indian contemporary recently, that tenders were required for the supply and erection of wiring conduits, &c., for the installation of electric light and motors in the new General Hospital at Rangoon, Burma.

Jamaica.—Kingston.—The president of the West India Electric Co., which is an entirely Canadian concern, received a telegram recently from Kingston, announcing that the Comptroller's office and most of the records were destroyed by the recent earthquake, but that the power house was not much damaged, and the transmission lines only slightly. The sub-station was badly sacked, and five cars were burned. It was not ascertained, however, at the time of telegraphing whether the dam and pipe line were intact.

Liverpool.—At the last meeting of the Mersey Docks and Harbour Board, the Works Committee recommended that the electric lighting at the Howley and Landon group of docks be improved at an estimated cost of £3,710. In accordance with the rule of the Board, decision upon the matter was postponed until the next meeting.

London.—L.C.C. Electric Power Bill.—The Finsbury B.C. has sent a circular letter to the other Metropolitan Borough Councils expressing strong disapproval of the Bill being proceeded with until the ratepayers have had an opportunity of expressing their views upon it, and intimating that it has decided to present a petition against the Bill and asking the Councils to take similar action. The Fulham B.C. has also sent a circular letter to the Metropolitan Borough Councils intimating that it has decided to oppose the preamble of the L.C.C. (Electric Supply) Bill on the ground of the same being in its opinion inimical to the interests of the Borough Councils as electricity undertakers, and otherwise unsound from the point of view of ratepayers, also that it has asked the local member of Parliament to use his influence to secure the rejection of the measure, and suggesting the desirability of a similar and uniform course of action on the part of other metropolitan local authorities.

The General Purposes Committees of the following Borough Councils have decided also to lodge petitions against the Bill:—Chelsea, on the ground that it seeks to abolish the Borough Council's right to purchase in 1928 the undertaking of the local Electricity Supply Co., also that it may impose a financial burden on the ratepayers of London; Lewisham is opposing in order to "protect" its interests; Hackney takes exception to the Bill mainly on the ground that "if the L.C.C. does not take over the Hackney undertaking it will nevertheless be a competitor for the supply of power, as the B.C. could not, if its charges were higher, reasonably withhold its consent to the supply of power, &c."; Camberwell, on general grounds. Stepney is petitioning against the Bill to obtain a *locus standi*. Although it considers the Bill an improvement upon the Bill of last year, it is, in its opinion, objectionable in several features; (1) the cost of a bulk supply to Stepney at the maximum prices would prove to be greater than that at which a supply is at present furnished by the B.C. to power-users, and is very much in excess of that offered by the Administrative County of London and District Electric Power Co. in 1905 and 1906; (2) the Bill would enable the L.C.C. to give a competitive supply to docks and to railway stations wholly situate within the area of a municipal authority possessing an electrical undertaking, without first obtaining the consent of

such authority; (3) the Bill does not indicate how the proportion of 20 per cent. of energy supplied to a power consumer, and which he may utilise for lighting purposes, is to be accurately checked for the purpose of determining whether such proportion has or has not been exceeded; (4) the Bill would enable the B. of T. to permit the L.C.C. directly to compete for private custom with existing municipal E.L. undertakers; (5) the provisions as to the breaking up of streets are not satisfactory; (6) the L.C.C. would be enabled in the absence of an agreement to take a transfer of undertakings of local authorities at its pleasure and option, it might take over a remunerative undertaking, and leave those which are unprofitable to their own resources. There was nothing in the Bill that compelled them to take such a transfer, although, after its passing into law, the operations of existing undertakings could be seriously restricted. While these restrictions are operative they may even compete with existing undertakings, as above indicated, after obtaining the consent of the B. of T. The undertakings should only be taken over on the basis of terms, and after proper investigation for the purpose of ascertaining and fixing the fair market value to be paid therefor; (7) the Bill makes no provision for electricity undertakings run in combination with dust destructors; (8) the Bill contains no provision making it compulsory for the L.C.C. upon its taking a transfer of an undertaking of a local authority to furnish a supply of energy to the public lamps. The Middlesex County Council are to lodge a petition against the Bill; Poplar is to lodge a petition against the Bill to secure a *locus standi*, but no expense is to be incurred without the further special sanction of the Council; the Greenwich B.C. is to petition because the L.C.C. have not replied to a letter asking them to accept protective clauses in the matter of breaking up streets, also on account of the enormous expenditure which would be necessary to carry out the provisions of the Bill; Wandsworth is opposing the Bill, because while admitting that legislation is required as the development of electricity in London is backward, it is not desirable that the County Council should become an authority to supply electricity in bulk or otherwise, and because the scheme is ill-considered, the proposed area of supply is too large, the proposal to purchase the undertakings of local authorities would involve much expenditure of public money without adequate return, the generating works of some of the local authorities being probably of less commercial value than the outstanding debts and liabilities; and further, because in the hands of the County Council the undertaking would result in a loss which under the provisions of the Bill is to be made good out of the county rate; also because the undertaking should be established and carried on as a commercial undertaking, the County Council to be controlling or supervising authority as in the E.L. Acts.

A large number of local authorities have also resolved to petition against the other London Power Bills to be promoted in the next session of Parliament.

The electric supply project was again discussed at some length at last Tuesday's L.C.C. meeting on a recommendation by the Parliamentary Committee in favour of confirming the resolutions passed on November 6th, 1906, with regard to the promotion of the London County Council (Electric Supply) Bill, 1907. A division eventually took place, and the recommendation was carried by 77 votes to 34.

The Council also decided to seal and present petitions, if necessary, against the following Bills:—Central London Railway, Great Northern and City, and the Watford and Edgware Railway; the London United Tramway Bill, and the Bills of the Administrative County of London and District Electric Power Co., the Electric Supply Corporation, London and District Electric Power, London Electric Supply, and the North Metropolitan Electric Power Supply Co.

Westminster and the L.C.C.—At the sitting of the City Council on Thursday last week, the Law and Parliamentary Committee brought up a long report on the L.C.C. Power Bill. The Committee pointed out that it would appear that the risks imposed upon the ratepayers were considerably greater than those involved in last year's claim, which it would be remembered met with the most emphatic condemnation by the County Council's own Finance Committee. Having regard to the proposal to acquire local undertakings, it was manifestly impossible even roughly to forecast the sums which would ultimately be required to carry out the scheme. With reference to the Administrative County of London and District Electric Power Bill, the Committee say that it is difficult to see the exact object of the Bill, for if the County Council Bill failed, the Bill would have little effect, and if the County Council Bill succeeded, it was highly improbable that the latter body would be content to farm out its powers to a private undertaking.

It was agreed that a petition be presented against the County Council Bill, but that no action be taken with regard to the Administrative Bill at present.

Reporting on the County Council Tramways and Improvements Bill, the Committee pointed out that in Clause 37 of the Bill the Council sought to alter the legislation by which it was compelled to remove from any street in which any tramway of the Council might be situated, any accumulations of matter removed from the conduit of such tramway, and seek power to deposit such matter in the receptacles belonging to the road authority, or by the side of the carriageway, for removal by the road authority. The Council decided to oppose this clause, and to communicate with the Metropolitan Borough Councils to find out what action they were taking in the matter.

Poplar.—In consequence of the Millwall Docks Co. having asked for a reduction in the price charged by the B.C. for energy, the latter has agreed to a supply being given on a flat rate of 3½d. for lighting, and 1½d. per unit, with discounts, for power. The price previously paid worked out, on the maximum demand system of 5d. and 3d., to 3·91d. per unit for lighting. No alteration has been made in the initial charge for power purposes.

Penge.—The South Metropolitan E.L. and Power Co. has applied to the B. of T. for sanction to lay a H.T. main to Penge to carry energy at 10,000 volts, in place of the existing main working at 3,000 volts.

Southampton.—On the recommendation of the borough electrical engineer and the Electricity Committee, the T.C. has decided to apply to the L.G.B. for sanction to borrow £17,000 for the provision of additional plant at the generating station, as follows:—Engine, generator and sundries, £10,200; boiler and accessories, £3,000; mains, £3,800.

Southport.—The residents of Ainsdale, who were canvassed by Southport T.C. as to a supply of energy to the district, have decided by a majority that they are not in favour of a supply.

United States—San Francisco.—It is reported that a financial deal involving the merging of the Western Gas and Electric and the Western Power Companies, which furnish power, light and heat to all the cities and towns in northern and central California, is being conducted by the Messrs. Goulds and Edwin E. Hawley, in New York, and by Messrs. J. Martin and Eugene de Sabla, in California. The sum involved is estimated at $25,000,000.

Worsley.—A local correspondent states that the Earl of Ellesmere is about to introduce electrical power at certain of his collieries and workshops in the locality.

Yardley.—After ascertaining upon what terms the Birmingham T.C. and the Shropshire, Worcestershire and Staffordshire Electric Power Co. would be prepared to take over the E.L. order, the R.D.C. has deferred consideration of the matter until the new council is elected in March next.

TRAMWAY and RAILWAY NOTES.

Belfast.—The Tramways and Electricity Committee considered the tenders received for extensions to the generating plant for operating the tramways, a week or so ago, and some interesting remarks were made by Mr. V. A. H. M'Cowen, the city electrical engineer. He reported that he had gone through tenders from 18 firms, which tenders comprised 53 alternatives for various combinations; he also examined 16 tenders for condensing plant. The offers for steam dynamos with reciprocating engines varied from £19,453 to £15,400. Mr. M'Cowen said he had received alternative offers for turbo-generators, and "as these are considerably lower in price than the reciprocating plant, I have carefully considered them, and examined some of the latest types of D.C. turbo-dynamos in operation. Hitherto there has been considerable trouble in connection with the commutation on turbo-dynamos, which has prevented me considering this type of plant before. Messrs. Brown, Boveri have now got over this difficulty, and I have seen their turbine-driven dynamos operating the tramways in Liége and Rotterdam most successfully, the commutation being excellent; in fact, quite as good as on slow-speed machines. I have, therefore, no hesitation in recommending this type of plant. Messrs. Willans & Robinson's tender for their own turbines coupled to Brown, Boveri dynamos, with delivery in eight months, would cost £14,956." He recommended the acceptance of this tender, and also the tender by the same firm for condensing plant. The Committee decided to accept the tenders of Messrs. Willans and Robinson for the two sets as recommended by Mr. M'Cowen, subject to confirmation by the City Council.

Blantyre.—The extension of the tramways connecting Blantyre with Cambuslang has been opened, joining the Lanarkshire tramways with those of the Glasgow Corporation. There is a complete tramway service now from Dalmuir to Wishaw, a distance of from 20 to 25 miles.

Bolton.—The Electric Tramways Committee on Tuesday last week, decided to arrange for a trial of a motor-'bus for the D'Arcy Lever district.

Bradford-Leeds.—According to the *Yorks Daily Observer*, an experiment was carried out about two months ago with an invention, which has been patented by the manager of the Bradford City Tramways (Mr. C. J. Spencer) and his assistant (Mr. Dawson), for enabling cars to travel over varying gauges. Since then, we understand, a car has been built with the new truck, and an informal trial run was made on the 22nd ult. As the gauges of the Leeds and Bradford tramways differ, any device which would permit of through running would be of considerable public advantage. Our lay contemporary states that the wheels on the new truck are mounted on sliding sleeves, and by unlocking they accommodate themselves to the lines at the junction of the systems.

Canada.—Ottawa.—A project is reported as being on foot for the construction of a new electric railway between Montreal, Ottawa, Kingston and other western points. It is stated that Mr. N. W. Leffler, head of the Leffler Electric Co., of Chicago, has been in Ottawa inquiring into the feasibility of the project, and also as to the possibilities of obtaining a charter.

Continental Notes.—Germany.—Plans are being prepared in respect of a projected electric tramway between Mörs and Homberg.

Croydon.—A scheme has been submitted to the Corporation for a service of through cars from Penge to Croydon, in place of stopping the cars at he boundary at South Norwood. The proposal has been supported by the Penge U.D.C.

Edinburgh.—Tramway matters in the Scottish capital appear to have assumed a more settled position. The T.C. has rejected a proposed electric trolley tramway known as the Dalkeith and Pleasance scheme, promoted by a company; it has also agreed to cable the Gilmore Place route and two other routes on the Leith side of the city (one of which was projected for overhead trolley working); so that the cable system will be maintained intact. The section between Tollcross and the Mound was interrupted for three hours on the 25th ult. owing to a cable being severed, and a further breakdown on another section has since occurred.

Glasgow.—Mr. James Dalrymple, general manager of the tramways, has drawn up a statement regarding the work of the department during the past six months. It states that the following extensions have been completed:—Possilpark to Lambhill, measuring 1 mile; the last portion of the Dumbreck extension, 3 furlongs; new line from Paisley Road toll to Govanhill, 1 mile 6 furlongs; Garngad Road line, 4 furlongs. In addition, the extension of the Dalmuir terminus beyond the canal only awaits the completion of the canal bridges. The line from Broomhouse to Uddingston was being pushed on with all possible speed. Regarding Pinkston power plant the manager states that the station was opened in 1901, and no additions had been made to the plant originally installed. The original cost of each section of plant was:—

Main engines	£102,350	15	0
Boilers	56,164	16	10
Electrical plant	44,066	9	7
Auxiliary plant	37,298	16	4
Coal handling plant	33,783	2	3
Sundries	26,217	17	9
	£299,881	17	9
Less spares	6,142	10	8
Total	£293,739	7	1

It was expected that in the summer the department would have inter-connection between Pinkston and the Port-Dundas station of the E.L. department, but assistance from this station could only be got during the summer months, as the peak load of both departments occurred in the winter months. By next year 700 cars would be running, which would mean that the whole four engines would be in use at one time. The Pinkston station was capable of accommodating a large amount of additional plant, and he would suggest that tenders be invited for two turbo-alternator sets of 3,000 kw. capacity each. It would be well that one of these be installed at once. The estimated cost with boilers, &c., Mr. Dalrymple put at £55,000. Dealing with the type of car to be used, he was forced to the conclusion that in Glasgow the single-truck car was the more useful. Three single-truck cars would cost £1,860, and would seat 186, while two bogie cars costing £2,100 would seat 152. The revenue from the former he estimated at £4,230 as against £2,820 for the two larger cars.

Japan.—Tokio.—The Tokio Electric Tramways Co. propose to construct another 60 miles of tramways. At the same time it is reported that a company has been formed with a capital of 15 million yen (about £1,500,000), with the object of constructing an underground (on the principle of the Metropolitan and the London Underground) railway at Tokio, which is to connect the widespread suburbs of that city with the centre. The line will be 12 miles long, and it is thought that with the cheap native labour 1,250,000 yen per mile, or £125,000, will be sufficient to cover the cost. It is proposed to charge a fare of 5 sen, or about 1·3d. Similar projects will also probably be prepared for other Japanese towns, which have a large areal extension.

London.—L.C.C.—At the meeting on the 29th ult. Captain Hemphill, in reply to questions, stated that in deciding to construct the Southampton Row—Aldwych subway for single-deck cars instead of double-deckers, the Council had the best advice from an engineering point of view, and it was on that account and after full consideration that the subway was built as it appeared. As to the suggested loss on the working of the subway cars, the latter were carrying a large number of passengers. The subway was built for through tramway traffic, and the line was not paying the whole cost of the subway. The Westminster Bridge—Embankment tramway, as far as could be judged seeing that the accounts were not fully closed, had resulted in a cost of £72,500 for trackwork and rails, and Parliamentary expenses had amounted to about £7,000 in addition.

The Council approved an expenditure of £26,463 for the construction on the overhead-trolley system of authorised tramways from Beresford Square, Woolwich, *viâ* Plumstead Road and High Street, Plumstead, to a point to the west of Wickham Lane. A vote of £7,525 was also sanctioned for the erection of a sub-station at Islington.

The Highways Committee of the L.C.C. proposes to arrange for the construction or reconstruction of about 48½ miles of track, or nearly 25 route miles, during the year 1907-8. Of this mileage the following nine schemes represent 30·66 miles of single line:—

(1) New tramway from Grove Vale, *via* Goose Green and Peckham Rye, to Stuart's Road, Peckham, 2·24 miles; (2) Existing tramways in Goswell Road, with exception of small portion of tramway which has been reconstructed, ·95 mile; (3) Tramways in Pentonville Road, between King's Cross and High Street, Islington, 1·61 mile; (4) Tramways in Gray's Inn Road, between Theobalds Road and King's Cross, 1·89 mile; (5) New tramways in St. John Street, from Rosebery Avenue to Aylesbury Street, and from Albermarle Street to a point near St. John's Lane, 1·15 mile; (6) Tramways from Greenwich Road, *viâ* South Street and Lewisham Road, to the Obelisk, Lewisham, and junction line along Blackheath Road to existing tramways in Deptford High Street, 2·46 miles; (7) New tramways from Hammersmith Broadway, *viâ* Queen Street, Fulham Palace Road, High Street, Fulham, and Putney Bridge, to Lower Richmond Road, 4·24 miles; (8) New tramways from Hammersmith Broadway, *viâ* Shepherd's Bush Road, Wood Lane and Scrubs Lane, to Harlesden, 6·00 miles; (9) Tramways from the junction of Whitechapel Road and Commercial Road, *viâ* Whitechapel Road, Cambridge Road, Mare Street, &c., to Stamford Hill, 10·12 miles.

No. 8 line is proposed for the overhead trolley system, all the others being for the underground conduit. The balance of 17·68 miles of single track is represented by the following lines, Nos. 13 and 17 being for the overhead trolley method:—

(10) Existing lines in Holloway Road, 4·10 miles; (11) Lines in City Road, 1·98 mile; (12) Lines in Hackney Road, 2·17 miles; (13) Tramways in Bow Road from Coborn Road to Bow Bridge, 1·55 mile; (14) Extension of tramways in Tooting High Street to the county boundary, near Longley Road, ·65 mile; (15) New tramways in Mitcham Road from Tooting High Street to the county boundary, 1·30 mile; (16) Tramways from Vauxhall Station, *viâ* South Lambeth Road and Stockwell Road, to Brixton Road, 3·43 miles; (17) Tramways from Beresford Square, Woolwich, *viâ* Plumstead Road, &c., to a point a little west of Wickham Lane, 2·50 miles.

A meeting of the "Tottenham Court Road Tramway Prevention Association" was held on the 28th ult. to prepare Parliamentary Opposition to the County Council's Bill, which, if passed, would authorise the laying of tramways along that thoroughfare. The association represents 90 per cent. of the tradespeople in the road.

Maidstone.—The T.C. has received from the B. of T. confirmation of the additional tramway scheme, by which the system is to be extended to Loose Valley, Penenden Heath, and Boxley.

Rawtenstall.—February 2nd has been fixed as the date for the poll of the ratepapers on the question of the extensions of the tramways from Waterfoot to Water. This is practically the only question in dispute, the Corporation having lightened their Bill by withdrawing the proposed tramway from Loveclough to Burnley. The ratepayers of Lumb Valley portion of the borough held a meeting on Friday night, when a resolution was passed demanding a tramway extension to their area.

Torquay.—The position of residents in this locality as regards public conveyance appears to be—like the policeman's life—not a very happy one. The motor-'buses, which, by the way, are stated to be from 2 to 3½ years old, and to have originally cost nearly £6,000, are to be sold for £2,500, involving a rate of depreciation not pleasant to contemplate. The grim humour of the situation is, however, only realised when it is stated that the 'Bus Co. has been earning substantial dividends, but is scared by *the prospect of the early running* of the Dolter tramways system, which has been installed in the town. If one may judge from Hastings experiences—and both Torquay and Oxford are following them with interest—the Bus Co.'s action appears somewhat precipitate.

York.—The York and District Tramways Co. has asked the Corporation to withdraw opposition to the company's Bill, but the Tramways Committee has resolved to recommend the Council not to adopt this course.

TELEGRAPH and TELEPHONE NOTES.

Conference of Municipalities.—Last week representatives of a large number of Scottish municipalities met at Edinburgh, to urge on the Government the necessity of extending the underground cable system to other Scottish cities besides Glasgow. A resolution to this effect was passed, and it was decided to send a deputation to interview the P.M.G. It is suggested that Aberdeen, Dundee, Arbroath and Montrose be connected with Glasgow and Edinburgh. In the recent storm Dundee and Aberdeen were practically isolated for more than two days.

Italy.—A Government Bill has been introduced by the Minister of Posts for the purpose of effecting improvements in the post and telegraph services. The Bill provides for an expenditure of £140,000 for extending the existing telegraph lines, £40,000 for new submarine cables and £80,000 for new apparatus. It is also proposed to extend the telephone system by an outlay of £320,000 for establishing 100 new connections between the most important towns. Stations for wireless telegraphy are likewise to be erected at Naples, Cagliari and Palermo, and the professional education of the intended *personnel* is to be provided for by the foundation of a post and telegraph instruction institute.

Telephone Agreements.—Last week, for the fourth time, the case of the P.M.G. *v.* King came before the City of London Court, this time for retrial. The agreement was fully explained to the judge by Sir Robert Hunter, solicitor to the G.P.O., and the judge stated that he at first thought the agreement was unreasonable, but was now satisfied that it was reasonable, though it might have been more clearly worded. Judgment was given for the P.M.G. for £3 12s. 4d., with costs, and leave to appeal was given.

(*Continued on page* 191.)

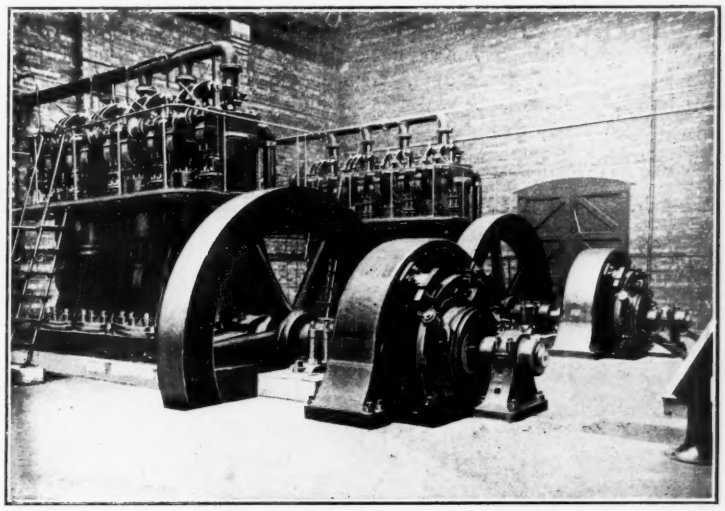
DIESEL ENGINE INSTALLATION, YORKSHIRE WEST RIDING TRAMWAYS.

The progress made by the Diesel oil engine as a prime mover, although but little referred to in print, can be gauged from the fact that some 130,000 B.H.P. of these engines are now in use.

It is probably the simplest of all internal combustion engines, and its high efficiency on what is really a residue fuel, costing some 2-2½d. per gallon, makes it a growing rival to both the gas and steam engine in the smaller and medium sizes.

This engine has been frequently described in our pages, and an exhaustive test on a 160-B.H.P. engine of this type, carried out by Mr. W. H. Booth, was recorded in our issue of November 4th, 1904.

One of the recent installations of the Diesel engine is at Castleford, where a small generating plant has been put down for supplying a portion of the West Riding Electric Tramways, with which are incorporated the adjoining Wakefield and District Light Railways (Electrical Review, December 16th, 1904).



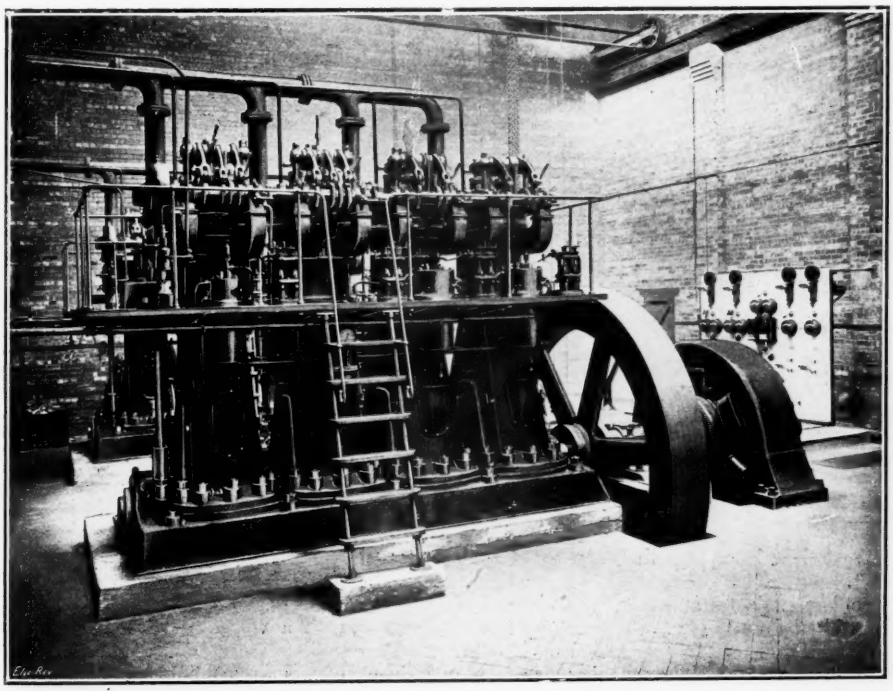
Diesel-Dick, Kerr Tramway Generating Plant, West Riding Tramways.

Between each engine and generator a 57-ton fly-wheel is mounted; the generators are six-pole compound-wound traction machines having an output of 200 KW. at 500-550 volts pressure, and 172 R.P.M.

The station buildings are simple brick structures, including in addition to the engine room, a separate oil store and offices.

The oil fuel is stored in two boilers, from which it is pumped into two containers situated in the engine room; the cooling water for the engine cylinders is drawn from the adjacent River Calder by means of Gwynne centrifugal pumps having a capacity of 1,500 gal. per hour.

The starting of the engines is effected by means of compressed air, and the fuel consumption of the engines is ·42 lb. of crude oil per B.H.P. at full load.



Four Cylinder 310-H.P. Diesel Oil Engines.

Two 310-H.P. engines are provided, direct coupled to Dick, Kerr tramway generators.

The engines were supplied by the Diesel Engine Co., and are, we believe, the first four-cylinder Diesels supplied; the cylinders are each 17¾ in. diameter by 26 in. stroke.

Even at light load this fuel consumption does not materially increase; per I.H.P. it decreases owing to the thermal efficiency (as opposed to the mechanical efficiency) rising to some 44 per cent.

Very finely graduated governing is obtained, the amount

of fuel admitted being determined by the governor at the commencement of the working stroke.

The engines are guaranteed to give the full B.H.P., with 10 per cent. overload for two hours, and momentary overloads of up to 20 per cent.

There exists a considerable field for the employment of the Diesel engine for driving isolated electrical plants ; indeed, one American writer has advocated their exclusive employment for driving tramway sub-stations in outlying districts, thus displacing electrical transmissions to those sections. Such a method would appear to be appropriate enough, in the case of a straggling system, and if, with American systems of interurban tramway construction, it could be proved that any financial advantage was derived, one would imagine that with the more costly English construction greater benefits would accrue.

ELECTRICAL INSTALLATION AT THE BRADFORD COLLIERY, NEAR MANCHESTER.

THE possible applications of electricity in mining work have so frequently formed the theme of comprehensive papers before engineering societies, that there is perhaps little new to be said here on the subject.

The great majority of colliery engineers and managers have favourably considered, and many of them have adopted, electricity for pumping, ventilating, small haulages and lighting work. Electrical coal cutting is also rapidly making headway, and may be regarded as an indispensable factor in the profitable working of many pits. Even the main winding engine cannot long remain steam operated, if the results obtained with the one or two plants which have recently started working over here, are in any way favourably comparable with their steam-driven predecessors—a matter which Continental experience would hardly seem to leave in doubt.

As things are, some account of a typical present-day electrical installation at the Bradford Colliery, near Manchester, which was carried out by Messrs. J. H. Holmes and Co., of Newcastle-on-Tyne, will be of interest to our readers.

In this case the power station plant includes four direct-coupled steam generators, three of which are used for power purposes and the fourth for surface and underground lighting work.

The engines were supplied by Messrs. Browett, Lindley and Co., and three are of the self-lubricating enclosed compound type, the fourth being an open-type engine.

Two of the engines are capable of developing 195 B.H.P. with 90 lb. steam pressure, and are fitted with special shaft governors and heavy fly-wheels ; these are coupled to two Johnson-Lundell six-pole traction generators, each with an output of 130 KW. at 525 volts and 380 R.P.M.

The generators are fitted with split laminated pole-pieces, having an extended pole tip on one side, so proportioned that this half of the magnet core is saturated by the shunt turns alone ; as the load increases, the compound winding quickly changes the induction density in the other half of the pole, at which point a strong field is required to obtain sparkless commutation at all loads. With cores of this description, it has been proved possible to employ a much smaller air-gap and to deal with greater armature reactions ; in practice these generators can run for short periods at 100 per cent. overload without altering the brush lead or causing destructive sparking.

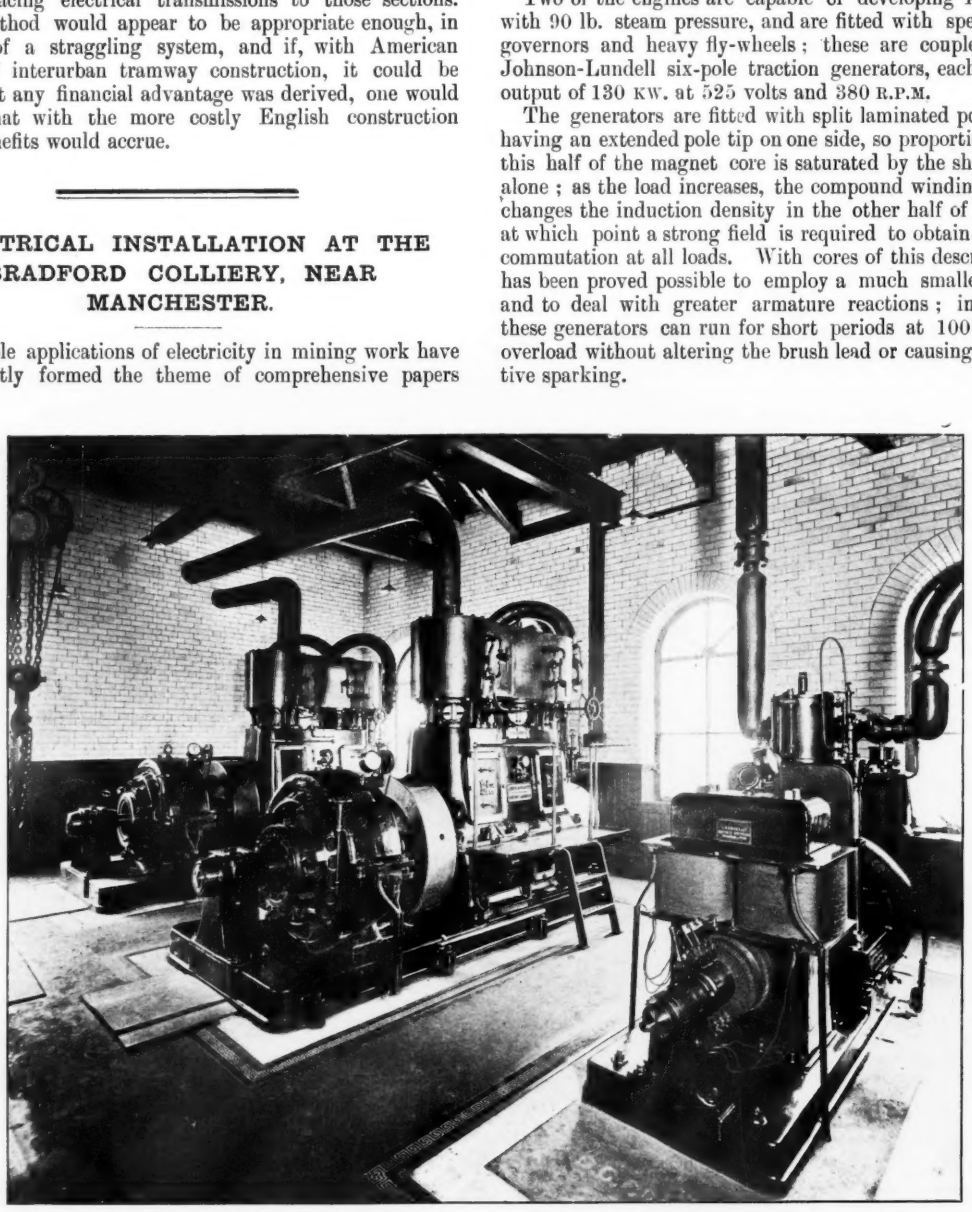


FIG. 1.—BROWETT, LINDLEY-HOLMES GENERATING PLANT AT THE BRADFORD COLLIERY.

The armatures are slot wound, and the bearings are self-adjusting and self-oiling.

The largest engine is of 500 B.H.P., and is coupled to a 340-KW. generator, with a voltage of 525 and a speed of 250 R.P.M. This engine is of the three-crank type ; the generator has eight poles of the Johnson-Lundell split pole type mentioned above, and the temperature rise on a six hours' test was only 40° F.

For surface and underground lighting a motor-generator and a "Castle" two-pole dynamo are provided. The latter has an output of 15 KW. at 230 volts pressure and 225 R.P.M., it is coupled to an open type single cylinder engine fitted with an automatic expansion governor and working at 90 lb. steam pressure.

The motor-generator transforms the power pressure down to 230 volts for the surface and underground lighting also.

The motor absorbs 70 B.H.P. at 525 volts, driving the generator, which has an output of 47 KW. at 230 volts, the combination running at 500 R.P.M. Both machines are of the "Castle" six-pole type, are of the same size, and designed for running continuously with a low temperature rise. The motor is shunt, and the generator compound-wound.

A complete main switchboard composed of enamelled slate panels is installed in the engine room; the generator panels are fitted with dead-beat ammeters, automatic circuit breakers, patent quick-break knife switches, and the necessary fuses. Dead-beat voltmeters and a clock are mounted in an ornamental pediment above the board.

The dynamo shunt regulating switches and resistances are of the firm's well-known switchboard type, arranged so that the resistance coils are coupled direct to the switch contacts at the back of the panels, no connecting wires being necessary for joining up the switches to the resistances. The feeder panels are fitted with double-pole knife switches and fuses; and a dead-beat ammeter is provided for each circuit.

The switchboards fitted near the various motors are each provided with an ammeter and an automatic circuit breaker to ensure the current being cut off should there be any accidental short circuit at the motor or an occasional overload.

The circuit breakers are found, as a rule, to prevent the fuses blowing, and so save considerable time in replacing them. Knife switches and fuses are also provided on these boards, and are enclosed in strong cases with glass fronts.

The India Rubber Co., of Silvertown, supplied the cables, the largest used underground being 61/·090. Armoured lead-covered cables of 2,500 megohms quality were used.

At the pit bottom the cables are so arranged that in the event of one pair of cables breaking down, they would be cut out, and the supply taken from one of three sets, until the repairs were effected, thus obviating the risk of a break-down in any part of the workings.

There are four haulages, three for endless rope and one for tail rope. Each of the endless rope sets is driven by a 65 B.H.P. enclosed "Castle" six-pole compound wound motor, designed to run at 300 R.P.M. on a 500-volt circuit.

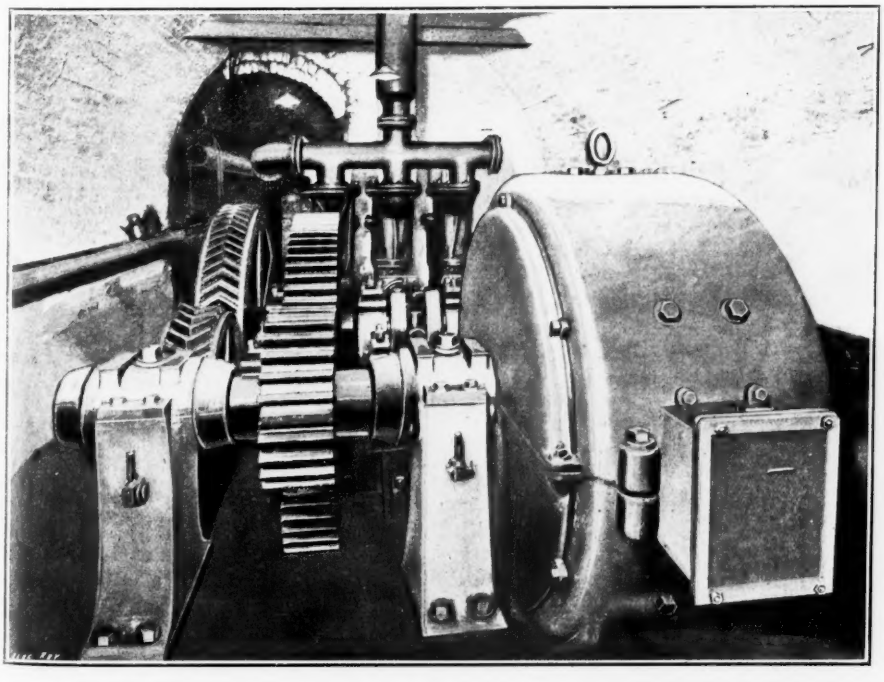


FIG. 3.—ELECTRICALLY-DRIVEN LOW-DUTY PUMP, BRADFORD COLLIERY.

The armatures are slot wound, and the motors are fitted on separate bedplates, each having three bearings fitted with ring lubrication and oil gauges. Grooved pulleys, 20 in. dia., are also fitted, to take 12 ¾-in. driving ropes.

The gear for endless rope haulage is mounted on an H section frame, conveniently arranged for taking underground and fitting up; it includes a first motion shaft driving the winding drum through double helical gearing. The first motion shaft is fitted with a split pulley, 6 ft. 8 in. dia. for 12 ¾-in. ropes, and runs at 110 R.P.M., from this the

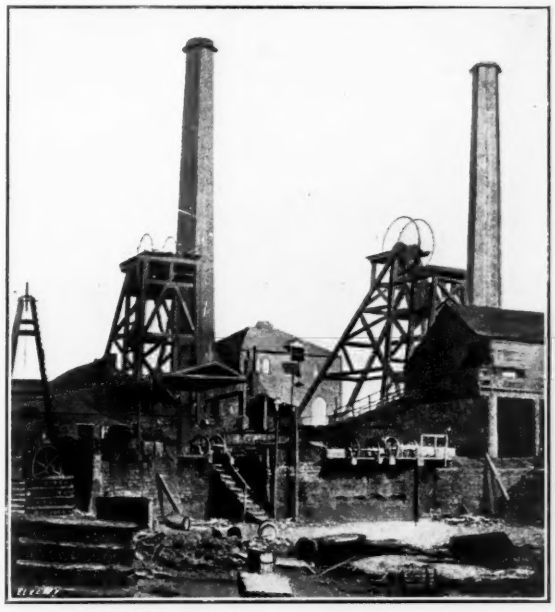


FIG. 2.—THE SURFACE WORKINGS, BRADFORD COLLIERY.

power is transmitted by double helical gear to the winding drum. The latter is 4 ft. 9 in. dia. by 8 in. face, and runs at 16·5 R.P.M.; it is fitted with cast-iron concave laggings which are made detachable, and these can be quickly removed and renewed on showing any signs of wear.

Attached to the side of the drum is the brake sheave; the brake is applied or released by a slow motion screw fixed to the lever arm. The hand wheel on the screw shaft is fixed near the starting switch for convenience.

One of the endless rope gears has an extended bedplate on which is temporarily fixed a tail rope drum, driven by an Ewart's chain from the first motion or rope-driven shaft. This is being used for driving a new brow downhill, during which time the endless rope drum is put out of gear. When this work is completed, the tail rope drum will be taken off and endless rope drum put to work.

The endless hauling ropes are 2,300, 1,000 and 900 yds. long, and can be worked at speeds of from 1½ to 3 miles per hour. To run each rope light takes 22 per cent. of the normal full power.

These sets have been running for nearly four years, during which time they have been worked to their maximum capacity without breakdown or stoppage.

The starting switches are of Messrs. Holmes's own make, specially designed to give slow and steady starting, and to permit of running from half to full speed. Each starting switch has two slates. On the short upper slate is fixed a single-pole switch, mechanically closed on the first turn of the slow-motion screw, and afterwards magnetically held on. On stopping or failure of supply, this switch opens, and prevents any damage arising from careless handling by starting the motor with all resistance cut out. To close the switch, all the resistance must be run in, and the operation repeated.

On the lower slate is fitted the bus-bar and the resistance section contacts. On the slow-motion screw a crosshead is carried, to which are fixed two sliding connectors or contacts connecting the bus-bar with the resistance sections.

The tail rope hauling set is similar to the larger set, except as regards the drum, and is driven by a 20-B.H.P. enclosed "Castle" six-pole motor with rope pulleys, as in the other cases.

Two sets of electrically-driven pumps are installed; a first reduction being machine cut-steel spur and pinion wheels.

Messrs. Holmes have also in hand at present for this colliery a 30-B.H.P. 520-volt, totally-enclosed motor, which will be used for driving screens and picking belts; and several smaller motors of 10-15 H.P. are employed in driving other machinery.

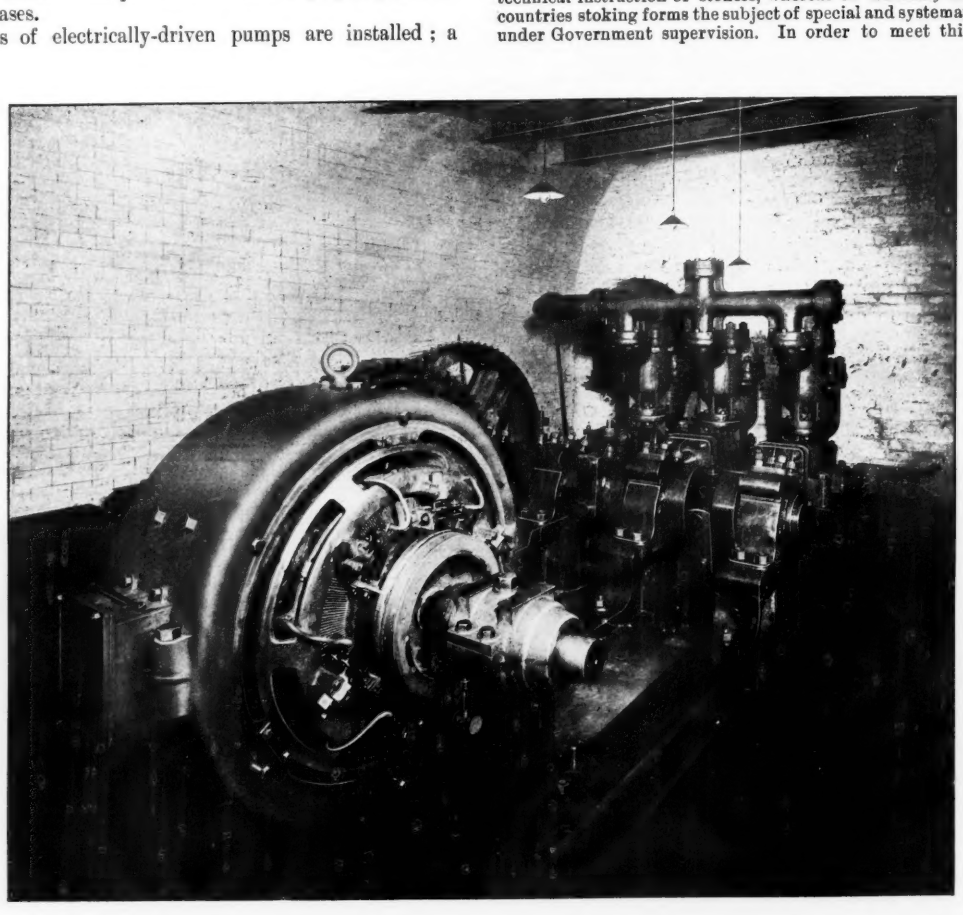


Fig. 4.—High-Duty Triple-Ram Pump, driven by Holmes Motor, Bradford Colliery.

high duty pump of Messrs. J. Evans & Sons' horizontal triple-ram type, with rams 6 in. dia. × 9 in. stroke, which when running at 40 R.P.M., delivers 5,500 gallons per hour, against a head of 1,680 ft.

In this case the motor is a 500-volt enclosed "Castle" six-polar machine, of 75 B.H.P., with a speed of 350 R.P.M. The power is transmitted through two reductions, the first being 12 ¾-in. ropes, as in the haulage, and the second double helical gear. Owing to the liability of this motor being flooded, it was raised to a higher level, and ropes were substituted for the original spur gearing first reduction. Starting and regulating switches and circuit breakers are fixed close to the pumps.

The low-duty pump is of the same type, but fitted with rams 8 in. × 9 in. stroke, and at 44 R.P.M., it delivers 12,000 gallons per hour against a head of 470 ft. This pump is driven by a 65-B.H.P. motor similar to the last named, running at 300 R.P.M., and is geared in a similar manner, excepting that the motor is mounted on an extended bedplate, the

Black Smoke and the Training of Stokers.—Evidence which the Coal Smoke Abatement Society has obtained in the course of its investigations, has conclusively established the fact that a large proportion of the smoke emitted from factory chimneys is the result of inefficient stoking. Manufacturers have, however, always experienced difficulty in obtaining the services of trained stokers, since no facilities have hitherto existed in London for the technical instruction of stokers, whereas in Germany and in other countries stoking forms the subject of special and systematic training under Government supervision. In order to meet this difficulty, the Coal Smoke Abatement Society has been able to arrange with the Governors of the Borough Polytechnic Institute for the holding of a special course of lectures and demonstrations upon the "Training and Work of Stokers." The course will comprise about 12 lectures, which will be given under the direction of Mr. W. H. Booth, assisted by Mr. W. H. Hildred, and will embrace special lectures to be given by Dr. S. Rideal, D.Sc., F.I.C., Mr. R. S. Richards and others. Practical demonstrations will also be given and visits arranged to central lighting stations and other large works where various types of mechanical stoker are in use. The Coal Smoke Abatement Society will offer certificates for competition amongst stokers attending the classes. The opening meeting, to which members of the public were invited, was to take place at the Borough Polytechnic on Wednesday, 23rd ult., at 8 30 p.m., when Commander W. P. Caborne, C.B., was to deliver a lecture upon the importance of good stoking, from the standpoint of the manufacturer, stoker and community. The fee for the course of lectures and demonstrations has been fixed at 2s, and in view of the importance of the experiment, it is hoped that manufacturers will provide their stokers with facilities to avail themselves of the opportunity of receiving special technical instruction. Further particulars may be obtained from Mr. C. T. Millis, M.I.M.E., the Principal of the Borough Polytechnic Institute, 103, Borough Road, Southwark, S.E.

TELEGRAPH and TELEPHONE NOTES.

(*Concluded from page* 186.)

Huddersfield.—The National Telephone Co. has obtained the permission of the Corporation to reconstruct the telephone system, and to lay the wires underground free of rental.

Submarine Signalling.—From recent Admiralty reports, it appears that the direction of a lightship equipped with the apparatus of the American Submarine Signal Co. can be ascertained with certainty at a distance of at least 10 miles, on a ship similarly equipped; this distance is more than double the range of the usual aerial sound signals. It was possible to hear the submarine bell by simply placing the ear against the ship's side below the waterline, at five miles distance, and it could be heard with the microphonic receivers up to 16 miles. The results are regarded as demonstrating that if the lightships round the coast were fitted with submarine bells, it would be possible for ships fitted with receiving apparatus to navigate in fog with almost as great certainty as in clear weather. The installation of submarine bells must come sooner or later, and will result in an immense saving of life, shipping and time.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	.. Aug. 26, 1901 ..	..
Paramaribo-Cayenne	.. Nov. 27, 1906 ..	..
Cayenne-Pinheiro	.. Aug. 18, 1902 ..	..
St. Lucia-Martinique	.. May 7, 1902 ..	..
Dominica-Martinique	.. May 7, 1902 ..	..
Guadeloupe-Martinique	.. Aug. 29, 1906 ..	..
Mole St. Nicholas-Port au Prince	.. Aug. 16, 1906 ..	..
Curacao-Coro Curacao-La Guayra } Closed.. Curacao-Maracaibo	.. .. Jan. 12, 1906 ..	..
Reissa-Issa and Reissa-Yemani (Yemen)..	.. Oct. 22, 1902 ..	..
Tarifa-Tangier	.. Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	.. Mar. 9, 1904 ..	..
Garachico-Santa Cruz	.. July 12, 1906 ..	..
Las Palmas-Arecife	.. Aug. 18, 1906 ..	..
Guantanamo-Mole St. Nicholas	.. Nov. 22, 1906 ..	..
Mole St. Nicholas-Cap Haytien	.. Nov. 22, 1906 ..	..
Fao-Bushire	.. Dec. 4, 1906 ..	..
Martinique-Paramaribo	.. Dec. 17, 1906 ..	..
Gibraltar-Tangier	.. Jan. 2, 1907 ..	Jan. 22
New Brunswick-Prince Edward Island ..	.. Jan. 9, 1907 ..	..
Landlines.		
Puerto-Barrios	.. Aug. 28, 1902 ..	..

Tyneside.—The Postmaster-General has sanctioned the reduction of the charges for trunk calls between the North Shields and South Shields areas, and has agreed to provide additional facilities for such calls.

Wireless Telegraphy.—The fast steamers of the North German Lloyd Steamship Co., which travel between Bremerhaven and New York, are equipped with wireless installations on the Marconi system, and the apparatus is operated by employés of the Marconi Co. Some interesting trials have been made on the *Kaiser Wilhelm II*, one of these swift vessels. The apparatus on this steamer is only calculated for a carrying distance of 200 nautical miles, but it has enabled connections to be established over distances which exceed anticipations. For instance, on the occasion of the last outward journey, communication was maintained from the *Haak* lightship near Texel, with the station at Crookhaven, at the south-western point of Ireland, a distance of 600 miles. On the return journey from New York the same steamer was in conversation with the *Nantucket* lightship, also for a distance of 600 miles, and on January 9th the vessel maintained connection with Sable Island for a distance of 800 miles. On January 12th the German steamer communicated with the Cunard Co.'s *Caronia*, which was journeying to Italy, and a comparison of the situations of both ships showed that the comparatively weak apparatus installed on the former had transmitted over a line of 1,050 miles. A second communication was established by the German steamer and the English vessel on January 15th, the latter then being to the south of Cape Sperone, the southern point of Corsica, and the other vessel in the neighbourhood of the *Haak* lightship—an air line of 1,200 miles; not only the continent, but also high mountain ridges must have been surmounted by this experiment. The most noteworthy point is that the transmitting apparatus of the German steamer had previously only been able to bridge over the above-mentioned great distances when the vessel had been at definite positions, and in point of fact, at the *Haak* lightship, and off the banks of Newfoundland, but similar attempts from other positions failed to accomplish the desired result. It is, therefore, assumed that the condition of the atmosphere at the positions in question is specially favourable for the transmission of wireless messages.

It seems that the notion that wireless messages cannot be tapped is ineradicable from the daily Press. Our esteemed contemporary the *Pall Mall Gazette*, usually so well informed, recently said that certain of our warships were to be fitted with "the new 'C tune' instruments. The outstanding feature of this 'tune' is that ships using it can speak to each other without their messages being tapped by other vessels. Of course, this is an enormous advantage, as it makes possible a safe interchange of confidential matters, whether foreign ships or stations are within the 'field' or not." But this is not so; any wireless message whatever can be tapped by anyone with the necessary apparatus and knowledge. All that can be done is to make tapping, at least casual tapping, unlikely.

The Marconi Wireless Telegraph Co., Ltd., reports that the wireless telegraph traffic for Marconi-fitted ships for 1906 is 1,261,000 words sent and received, as against 783,950 words in 1905.

CONTRACTORS' COLUMN.

Openings for New Business.

RINGWOOD (Hampshire).	New Council School for Local Education Authority.
CARMARTHEN (Ammanford).	New Council School for the Education Committee, Carmarthenshire County Council. W. D. Jenkins, architect.
CROSSKEYS (Mon.).	Additions at Tredegar Arms Hotel. Lansdowne and Griggs, architects, Metropolitan Bank Chambers, Newport, Mon.
CLACTON-ON-SEA. (£1,389.)	New Model Laundry, Convalescent Road. Baker and Wrightson, architects. H. Smith, Clacton, builder.
RAWMARSH.	Wesleyan Church. W. J. Hale, 13, St. James's Row, Sheffield, architect.
ESSEX.	Large new school for technical instruction, for the Essex County Council.
PORTADOWN (Dublin).	New fancy and cotton goods factory for Spence Bryson & Co.; jam factory for Chapman, Ltd.
ST. ANNES-ON-THE-SEA.	Wesleyan Church and Schools enlargement. Walker & Collinson, architects, Cheapside Chambers, Bradford.
HACKNEY.	Public Library.
OLD TRAFFORD.	New buildings and works at the Botanical Gardens. Chas. Heathcote & Sons, architects, Manchester.
BURWASH (Sussex).	New Institute. Chatfield Clarke, architect, 63, Bishopsgate Street Within, E.C.
LEEDS.	Brewhouse and conveniences, &c., for the Corporation. G. Watkinson, architect, Mark Lane, Leeds.
LIVERPOOL.	New church (in memory of late Right Hon. Samuel Smith) in Aigburth Road.
BRADFORD.	St. Joseph's College. E. Simpson, architect, 12, Cunliffe Terrace, Manningham.
SALTAIRE.	Extensions to Saltaire mills of Sir Titus Salt' Bart., Sons & Co.
LANGWITH (Derby).	Isolation Hospital for the North Derbyshire Hospital Committee. Rollinson & Son, Corporation Street, Chesterfield, architects.
GLASGOW.	Alterations and additions to Pinkston power station. James Dalrymple, general manager, 46, Bath Street, Glasgow.
LINCOLN. (£15,000.)	New theatre. W. Hancock, Leicester, architect.
MANCHESTER.	Grange Street Special Municipal School. W. H. Talbot, Town Clerk, Education Offices, Deansgate, Manchester.
BURNLEY.	New County Court, for Commissioners of H.M. Works and Public Buildings. Secretary, H.M. Office of Works, &c., Storey's Gate, S.W.
SURREY.	Small-pox Hospital (2 miles from Clandon Station on the L. & S.W. Ry.). Widnell & Trollope, 20, Tothill Street, S.W., architects.
MACHYNLLETH (Montgomeryshire).	Proposed new drill-hall for local company o Volunteers.
CLOWN (near Sheffield).	New parish church.
STAFFORDSHIRE.	New schools at Brockmoor and Wordsley for the Staffordshire Education Committee.
MEDWAY.	New laundry building and bakery at Chatham, for the Medway Guardians. Architect, E. F. Cobb, 20, High Street, Rochester.
HARBORNE.	New fire station.
BORDESLEY GREEN.	New police station.
COLCHESTER.	Large secondary school for the County Education Authority. Also new cavalry barracks.
PENKETH (near Warrington).	New public elementary school (350 scholars) for the Lancashire Education Committee. Architect, H. Littler, 16, Ribblesdale Place, Preston

CONTRACTS OPEN and CLOSED.

OPEN.

Belfast.—February 11th. Boilers, superheaters, stokers, &c., for the tramways and electricity department. See "Official Notices" January 15th.

Belgium.—March 30th. The municipal authorities of Liége invite tenders for a central station. For further particulars see our issue of January 25th.

Berlin.—February 20th. The Prussian Government Railways require tenders for insulators, bronze wire, galvanised wire, copper wire, &c. Particulars may be obtained by enclosing 6d. to the Director Eisenbahn Telegraph Amt.

Bermondsey.—February 6th. Carbons, conduits, meters, cables, &c., for the electricity and destructor department of the Council for one year. See "Official Notices" January 11th.

Birkenhead.—February 4th. Stores for the electricity and tramways department.

Blackburn.—February 18th. Stores for the Electricity and Tramways Committee for one year. See "Official Notices" to-day.

Bremen.—February 18th. Tenders are required for the equipment of water turbine works for operating five 400-KW. (each) polyphase generators, at 40 revolutions, to supply three-phase current at 7,000 volts. The generators are ultimately to be direct-coupled to water turbines by vertical shafts. Particulars may be obtained, at 1s. (not in stamps), from the Verwaltung der Unter-Weser-Correction Freibezir, Room No. 105.

Bridlington.—Wiring for the New Theatre and Opera House at the Spa Gardens. Mr. H. Hague (manager). Deposit (returnable) two guineas.

Christiania.—February 11th. Tenders are invited for the supply to the Norwegian State Telegraphs of 70,000 insulators. The insulators are of two patterns and are to be tendered for separately. Conditions and specifications with drawings to be seen at the offices of the Commercial Intelligence Branch, B. of T., 73, Basinghall Street, E.C.

Christiania.—February 15th. The Commercial Intelligence Branch of the B. of T. is informed by the Acting British Consul at Christiania that tenders are invited by the Norwegian State Railways for the supply of telegraph insulators, 10,000 large and 7,000 small. Tenders sealed and marked "Anbud paa Telegrafisolatorer," will be received at Jernbanestyrelsens Expeditionskontor, Christiania, up to 3 p.m. on February 15th. Copies of conditions of tender (in Norwegian), together with drawings, &c., may be seen by British makers at the offices of the Commercial Intelligence Branch, 73, Basinghall Street, London, E.C.

NOTE.—Apart from the usual Customs duties, a preference of from 10 to 15 per cent. is given to Norwegian manufacturers. In all cases of Norwegian Government contracts, it is obligatory that a resident agent should act for tenderers not residing in Norway, and be responsible to the Government, but it is not necessary for the agent to be a Norwegian firm.

Copenhagen.—February 11th. The Government Railways Department requires tenders for pumps. See issue of January 25th.

Copenhagen.—March 18th. Two steam turbine alternators (three-phase), 2,500 KW. each, for the Corporation. See "Official Notices" January 25th.

Darlington.—February 8th. One 500-KW. dynamo and engine for the Corporation. See "Official Notices" January 25th.

Derby.—Electric lighting for Highfield Congregational Church. Architects, J. Wills & Sons, St. Peter's Church Yard, Derby.

Eastbourne.—February 11th. One 750-KW. steam turbo-alternator and condensing plant for the Corporation. See "Official Notices" January 18th.

Eccles.—February 9th. The Education Committee invite tenders for electric light wiring, fittings, switches, &c., at the Lewis Street Schools. Particulars, on payment of a deposit of 10s. 6d., from Mr. Edwin Parkes, Town Clerk.

Edinburgh.—Condensing plant for the Corporation electricity supply department. See "Official Notices" January 25th.

Edinburgh.—February 18th. Exhaust steam turbines and D.C. generators for the electricity station in M'Donald Road. See "Official Notices" January 25th.

Hammersmith.—February 6th. Stores for the electricity department for one year. See "Official Notices" January 25th.

Hammersmith.—February 6th. Plant for converting single-phase alternating current to continuous current for the Council. See "Official Notices" to-day.

Iceland.—March 31st. The Reykjavik Town Council is open to give a concession for the supply of electrical energy and gas. See "Official Notices" December 7th.

Leith.—February 6th. One 600-KW. steam dynamo and one water-tube boiler for the Corporation electricity department. See "Official Notices" January 25th.

L.C.C.—February 12th. Installation of electric light, motors, bells and fittings, for the Hammersmith Technical Institute. See "Official Notices" to-day.

Middlesex.—February 13th. Tenders for the construction of track-work for electric tramways along Harrow Road, and at Willesden and Acton. Mr. H. T. Wakelam, M.I.C.E., County Engineer, Middlesex Guildhall, Westminster, S.W.

Perth (Western Australia).—March 25th. The Postmaster-General invites tenders for lead-covered paper-insulated telephone cable, as specified hereunder:—Two miles of 208-pair (20 lb. conductors); 110 yards of 156-pair (20 lb. conductors); 660 yards of 104-pair (20 lb. conductors); and 880 yards of 52-pair (20 lb. conductors). A deposit or deposit receipt is required to the amount of 5 per cent. of the first £1,000 of the tenders, and of an additional 2½ per cent. of any amount in excess over £1,000. Particulars may be obtained at the General Post Offices, Perth, Melbourne, Sydney, Adelaide and Brisbane.

Salford.—February 9th. One motor for driving a 150-KW. alternator for the Electricity Committee. See "Official Notices" January 18th.

Salford.—February 16th. Supplies for 12 months, including cables, meters, arc lamp carbons, lamps, switches, motors, motor-starters, instruments, &c. See "Official Notices" to-day.

Sheffield.—February 6th. Tramway stores for the Corporation. See "Official Notices" January 25th.

South Australia.—March 6th. The Postmaster-General requires tenders for telephone and telegraph material. For particulars see our issue of January 18th.

Southampton.—February 4th. Underground cable for the Corporation. See "Official Notices" to-day.

Spain.—February 6th. The municipal authorities of Le Seca (province of Valladolid) are inviting tenders for the concession for the electric lighting of the town during a period of 10 years. Tenders are to be sent to El Secretario del Ayuntamiento de Le Seca, whence particulars can be obtained.

Spain.—February 10th. The municipal authorities of Lupion (province of Jaen) are inviting tenders for the concession for the electric lighting of the town during a period of 10 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Lupion (Jaen).

Spain.—Tenders have just been invited by the municipal authorities of Ribas (province of Gerona) for the concession for the electric lighting of the town.

Sydney (N.S.W.).—March 6th. Tenders for the supply of 7½ tons of hard-drawn copper wire, 200 lb. per mile. For further details see our issue of January 25th.

Walthamstow.—February 8th. Water-tube boilers, coal-conveying plant, engines and dynamos, condensing plant, water purifying and softening plant, and switchboard extensions for the U.D.C. electricity works extensions. See "Official Notices" January 25th.

West Ham.—February 7th. Tenders for supplies, including incandescent lamps, cables and wires, &c., motors, transformers and wattmeters. See "Official Notices" to-day.

Wishaw.—February 5th. Tantalum lamps for the burgh. See "Official Notices" to-day.

CLOSED.

Delhi.—We are informed that a good start has been made with the construction of the new electric tramways in that city. The scheme includes some 10 route miles of track and 22 cars, together with car-sheds, power station, overhead distribution, and a considerable amount of public and private lighting work. The whole contract is being undertaken by Messrs. Bruce Peebles and Co., Ltd., who are themselves manufacturing all electrical apparatus required. An interesting feature of the installation will be the extensive use of lattice steel poles, in place of the ordinary wooden or tubular poles.

London.—STEPNEY.—The B.C. received the following quotations for 10,000 pairs of carbons for new arc lamps:—

Union Electric Co.	(accepted)	£120 10
Sloan Electrical Co.		128 16

WANDSWORTH.—The B.C. has accepted the tender of the Albion Electric Lamp Works for the annual supply of electric lamps.

L.C.C.—The L.C.C. has accepted the tender of Bolckow, Vaughan and Co., amounting to £31,230, for the supply of track rails and fastenings for further sections of the tramways, and that of the Frodingham Iron and Steel Co. for the delivery of slot rails and conductor tee rails for the sum of £23,047. The complete list of tenders was given in this column a week ago.

MARYLEBONE.—The B.C. has accepted the tender of Messrs. J. T. Williams & Sons for the purchase of six disused turbo-generators, for £1,085 10s.; also the tender of Messrs. A. Learoyd for the purchase of 20 feeder panels, for £116 10s.

Loughborough.—The T.C. has accepted the tender of the Brush Electrical Engineering Co. for the supply of a spare armature, at £372, and a turbo spindle, at £292.

The Corporation Electricity Department has accepted the tender of the Chloride Electrical Storage Co., Ltd., for a storage battery, for £1,120.

Melbourne (Victoria).—The Corporation has accepted the following tenders for the further equipment of its electric lighting station :—

One direct-current dynamo and engine, £4,650.—Australian General Electric Co.
Two steam turbo-alternators, £10,664.—Noyes Bros., Melbourne.
53 transformers, £2,700; high-tension alternating current switchboard, £790.—Australian General Electric Co.

Mussoorie.—A commencement has been made upon the work in connection with the contract recently secured by Messrs. Bruce Peebles & Co. for a hydro-electric power station for the municipality of Mussoorie, India. The installation includes three high-tension alternators, driven by water wheels, together with some miles of high-tension overhead transmission, and, of course, all hydraulic and constructional work necessary for the development of the water power, the whole job bearing, in fact, a resemblance in miniature to Messrs. Bruce Peebles's work in North Wales. The firm's engineer-in-charge of the contract, Mr. J. S. Pitkeathley, has recently arrived upon the scene, and his address for the present is—care of Electrical Engineer, Municipal Board, Mussoorie, India.

Portsdown and Horndean.—The D.P. Battery Co., Bakewell, have secured the contract for 260 980-ampere-hour cells for the Portsdown and Horndean Light Railway.

FORTHCOMING EVENTS.

To-day's Events (Friday, February 1st).—Northampton Institute Engineering Society. Mr. E. Graves on "A Few Points in Connection with A.C. Traction."

Saturday, February 2nd.—Institution of Electrical Engineers (Glasgow). Annual Smoking Concert.
At 2.30 p.m. Institution of Electrical Engineers (London Students). Visit to G.P.O. Telephone Exchange.
Monday, February 4th.—At 7.30 p.m. Society of Engineers. Inaugural address by Mr. Richard St. G. Moore.
At 8 p.m. Institution of Electrical Engineers (Newcastle). Mr. G. Ralph on "The Electrical Installation at the Grangesberg Mines, Sweden."
Tuesday, February 5th.—At 7.30 p.m. Institution of Electrical Engineers (Manchester). Mr. G. W. Worrall on "Magnetic Oscillations in Alternators, and their Bearing upon the Design."
At 8 p.m. Institution of Civil Engineers. Col. R. E. B. Crompton on "Modern Motor-Vehicles."
Thursday, February 7th.—At 8 p.m. Institution of Electrical Engineers (London). Conclusion of discussion on Mr. C. C. Paterson's paper. Paper by Messrs. H. F. Haworth, T. H. Matthewman and D. H. Ogley on "Comparative Life Tests on Carbon, Nernst and Tantalum Incandescent Lamps Using Alternating Currents."
At 8 p.m. Institution of Electrical Engineers (Dublin). Adjourned discussion on paper by Mr. A. E. Porte on "Notes on Suction Producer Plants."
At 8 p.m. Civil and Mechanical Engineers' Society. Mr. W. W. F. Pullen on "Some Forms of Dynamometers."
At 8.30 p.m. Chemical Society. Meeting.
At 3 p.m. Royal Institution. Major P. A. MacMahon, D.Sc., on "Standards of Weights and Measures."
Friday, February 8th.—At 8 p.m. Physical Society. Annual General Meeting. Presidential Address. Mr. A. Russell on "The Magnetic Fields and Inductive Coefficients of Circular, Cylindrical, and Helical Currents."
Armstrong College Engineering Society.—Mr. C. R. M. Young on "Brakes."
Saturday, February 9th.—At 2 p.m. North of England Institute of Mining and Mechanical Engineers. Meeting.
Institution of Electrical Engineers (Manchester Students). Annual Dinner.
Junior Institution of Engineers. Anniversary Dinner at the Hotel Cecil.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are issued :—

Monday, February 4th.—"A" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.
Tuesday, February 5th.—"B" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.
Wednesday, February 6th.—"A" Badge examination.
Thursday, February 7th.—"C" Company, technical instruction, 7 p.m.
Friday, February 8th.—"D" Company, recruits' infantry drill, 6 p.m., technical instruction, 7 p.m.
Week-end training at Tilbury for "C" Company on Saturday, February 2nd.

J. H. S. Phillips, Captain, for Adjutant,
For O.C.E.E.R.E. (V.)

"Helis" Dry Cell.—A new patented type of dry cell known as the "Helis," which besides possessing the qualities of a good primary cell, can be repeatedly re-charged, has been put on the market by the Helis Cell and Accumulator Co., Ltd., of 53 and 54, Chancery Lane, W.C. The cell is made in England.

NOTES.

Fatal Foolhardiness.—Upon occasion, it seems, even the lay Press can acquit itself creditably when handling technical subjects, and an article in the *Standard* of the 24th ult. is a case in point. Quite evidently it was not written by one of the *Standard's* young men, but flowed from the pen of an expert, who deals in a manner which cannot be praised too highly with the carelessness born of familiarity, with the sheer neglect of simple regulations, and with the perilous absent-mindedness, which strike with sudden death a yearly increasing number of victims. He cites the recent instance of the horrible death of a danger-careless installation inspector in London, and the older case at Hastings, when an engineer was killed while showing someone round the power station. Whatever precautions are required of the undertakers, and however stringent and numerous the local rules may be, such lamentable accidents will happen; but we feel with Mr. G. S. Ram that there is much still to be done by the designers and users of electrical plant before they can rest content that all accidents must be due to want of reasonable care on the part of the victim. Wiring contractors are liable to especial condemnation on this count, and electricity supply authorities should look well to it both that their regulations move in advance of the times, and that no connection is made until every part of the installation complies with them. Only so, in the too frequent absence of an adviser on the customer's behalf, will the fullest degree of safety be assured.

Institution Notes.—Junior Institution of Engineers.—With the permission of the President of the Royal Naval College, Greenwich, Admiral Sir A. D. Fanshawe, K.C.B., and the assistance of Dr. James A. Ewing, F.R.S., Director of Naval Education, upwards of 100 members of this Institution visited the College and precincts on Saturday afternoon, January 19th. In the new engineering laboratories they were met by Dr. Ewing, Vice-President of the Institution. All the apparatus, &c., was on view, including that used to demonstrate Dr. Hele-Shaw's "Stream Lines," shown by Mr. John Smith. The laboratory is equipped on research lines, and not for elementary teaching, since the engineering students have had a five years' course at Keyham College and Devonport Dockyard on the "sandwich" system before going to Greenwich. The course extends to one year for the average student, and to three years for the best students, who are destined later for expert work at the Admiralty or Dockyards. The equipment of the laboratory comprises a 2,000-H.P. triple-expansion steam engine, *ex* H.M.S. *Rattlesnake*; a 45-H.P. Belliss engine and Siemens dynamo; a 45-H.P. Parsons turbine dynamo; a 30-H.P. de Laval turbine dynamo; a 15-H.P. Diesel oil engine; a 9-H.P. Crossley gas engine; a 12-H.P. Thorneycroft petrol engine and Siemens dynamo; a small Hornsby oil engine; a 10-H.P. air refrigerating plant; a three-stage torpedo air compressor; an 18-in. torpedo; a hydraulic pumping engine; two hydraulic motors; a Babcock & Wilcox water-tube boiler; superheater, separately fired; a water softening plant; a White-Forster boiler with oil fuel; a 100-ton and 5-ton Wicksteed testing machine; a complete Zeiss apparatus for the study of the microstructure of metals; a well-equipped workshop for making and repairing apparatus; and a good equipment of measuring apparatus of all kinds used in experimental work. At the conclusion of the visit the party were entertained to tea by Dr. Ewing.

The Arc Works Engineering Society, Chelmsford.—The following Wednesday evening lectures (at 7.45 p.m.) have been arranged by this Society :—

January 30th.—"Modern Foundry Practice," by D. Wilkinson.
February 6th.—"Electricity Meters and Systems of Charging," by E. S. Shoults, A.M.I.E.E.
February 13th.—"Switch and Switchboard Design," by R. C. Harris.
February 27th.—"An Elementary Introduction to the Subject of Electromagnetism and Electrical Machine Design," by W. J. MacFarlane, Wh.Sc.
March 6th.—"Recent Developments in Electrical Machinery," by H. Burge, A.M.Inst.C.E.

Northampton Institute.—On Friday last Mr. Evan Spicer, chairman of the L.C.C., distributed the prizes and certificates to the students. Dr. R. Mullineux Walmsley, the principal, in his report, said that there had been a small increase in the number of evening students, but an increase of 16 per cent. in the apprentices and improvers. The adoption of the four years' day course in engineering was fully justified. Mr. Spicer congratulated the Institute upon its rapid progress in the electrical and engineering classes, and added that he had been assured by an eminent electrical engineer that the work done in the Institute was second to that in no other polytechnic. The members' and students' conversazione was held on Saturday evening.

Aberdeen Mechanical Society.—On January 25th, Mr. A. H. M'Kay, of the Corporation electricity works, read a paper on "Notes on Electric Motors."

Royal Society.—Among the papers down to be read at yesterday's meeting were :—"On the Explosion of Pure Electrolytic Gas," by Prof. H. B. Dixon and Mr. L. Bradshaw, and "On the Discharge of Negative Electricity from Hot Calcium," by Dr. F. Horton (communicated by Prof. J. J. Thomson).

A Passenger's Claim.—Mrs. Theodosia Gunn and her husband claimed damages against the Tynemouth and District Electric Traction Co., Ltd., because the former, who weighed 15 st., was thrown from a car seat to the floor by the sudden pulling up of the car. Judge Greenwell, at Newcastle, found for the defendant company, negligence not having been proved.

Parliamentary.—Scotch Bills in Parliament.—On Friday the Examiners of Standing Orders had before them the Scotch Orders which are being promoted under the Private Legislation Procedure (Scotland) Act. These orders will not come before the Select Committees of the House of Commons, unless the House decides that they shall proceed by way of Private Bills. Standing Orders were found to have been complied with in the case of the following Bills which deal with electricity:—

Aberdeen Corporation.—This Bill deals with various matters, and for extending the area for the supply of electricity, and provides for the purchase of the undertaking of the Deeside and District Electric Supply Co.

Dundee Corporation.—Under this Bill, authority is sought to extend the borough boundary, and to extend the electric lighting order of the Corporation to include the added area. There is also power to construct several other tramways.

Electric Supply Corporation.—This is a Bill for transferring to the Electric Supply Corporation, Ltd., certain undertakings authorised under the Electric Lighting Acts granted to Messrs. Crompton & Co. The undertakings refer to Dalkeith, Dollar, Jedborough and Melrose.

Edinburgh Corporation.—By this Bill power is taken to make and maintain works for conveying the water for condensing purposes to the McDonald electric power station of the Corporation

In the case of the Portobello and Musselburgh Tramways Bill, by which authority is sought to enable the tramway company to construct tramways in the Borough of Musselburgh, the promoters failed to comply with Standing Orders, and the matter will be reported to the House.

The consideration of the Glasgow Corporation Bill was postponed till February 14th, and the Edinburgh Corporation and Suburban Tramways Bill was also postponed till the same date.

Standing Orders.—On Monday, the Examiners considered a number of Bills, but the following electricity Bills were postponed:—Barnsley, Wombwell and Wath Tramways till February 14th; the Rawtenstall Corporation and the Cavehill and Whitewell Tramways Bill till February 14th.

Electric Shock Fatality.—Oswald Clegg (17) was killed on January 21st by coming into contact with a live wire at Hartley Bros.' leather works at Ravensthorpe. His body was found against one of the motors. He had received a low-voltage shock. The jury found that death was due to an electric shock received through misadventure, while interfering with the electrical apparatus.

Appointments Vacant.—Cable-jointer for Weymouth and Melcombe Regis (35s.); a shift engineer is required for Erith at £104 per annum. See advertisement pages to-day.

Tantalum.—"Falx" asks: "What is the current price of tantalum, and where can it be bought?" We understand that it can practically only be obtained, if at all, through one firm (Messrs. Siemens & Halske, of Berlin). The price we are unable to state.

Oxford.—Sir A. K. Rollit will act for the Oxford Tramway Co., and Mr. James Swinburne for the National Electric Construction Co., as arbitrators in settling the price to be paid for the Oxford Tramways by the latter company.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Engineers.—The staff at the Worcestershire electricity works have presented a Worcester porcelain loving cup on an ebony plinth to Mr. T. H. Birrell, mains superintendent, on resigning his position.

The Bradford Electricity Committee has received 121 applications for the post of assistant electrical engineer, and the number has been reduced to 10.

Mr. William Bates has resigned the position of borough electrical engineer to the Corporation of Birkenhead to take up a position with Messrs. R. & J. H. Rea, of Liverpool.

Mr. C. H. K. Chamen has resigned his position as mains superintendent of the Lancashire Electric Power Co. to join the staff of Messrs. Siemens Bros.' Dynamo Works, Ltd., at their Manchester branch office, 196, Deansgate, Manchester. He will commence his new duties at the beginning of March next.

On Friday last the annual dinner of the Tunbridge Wells Electricity Works was held. Among those present were Mr. Horace Boot, M.I.E.E., A.M.I.Mech.E., &c., in the chair; Mr. Councillor Carpenter, Mr. Councillor Edwards, Mr. Councillor Brown, Mr. D. Smith, chief assistant electrical engineer, and Mr. H. T. Bates, of the Sutton Electricity Works. The toasts were interspersed with a musical programme, supplemented by the Works String Band. The principal toast of the evening was "His Worship the Mayor, and Members of the Electricity Committee," which was given by the chairman. Mr. Councillor Brown responded. The toast of "The Electricity Undertaking," was given by Mr. Councillor Carpenter. He pointed out how much he regretted they did not carry the clause in their "hiring" Bill, as he felt certain that it would have been of great service to the undertaking. However, in the course of a few years, he had no doubt that Parliament would sanction the hiring out of motors, arc lamps and wiring, as a matter of course, and give them the same powers that the gas companies possessed. As a member of the Lighting Committee for some considerable time, he claimed to know something of the abilities of their chief engineer, Mr. Boot, and he felt sure the town might place every confidence in him to continue, as he had done in the past, the success and growth of the undertaking. Already additions were being talked about, and he hoped it would not be long, owing to the continual progress, before they would be asking the Council to sanction the installation of a large turbine plant. Mr. Boot, the consulting engineer and general manager, in an interesting speech, stated how proud he was that evening to look back on the wonderful progress the undertaking had made. He had now advised them and been responsible for the carrying out of all the work since the inauguration twelve years ago, and during that time he had seen various phases of municipal trading and enterprise. In an amusing dream, in which he was visited by the fairy goddess "Electra," he foreshadowed the future of the electricity undertaking, and pointed out how some of this could be achieved by the introduction of metallic filament lamps, more economical generating plant and a useful day load, with an improvement in the load factor. The business was an exceedingly difficult and responsible one to manage, and he thanked his Committee most heartily for the able manner in which they assisted him in the onerous duties. The success of the undertaking depended very largely on the advice given with respect to the expenditure of capital, and many undertakings which had great prospects had been ruined owing to faulty advice given by their consulting engineers; it was no good having great economy at the works and a wasteful expenditure of capital going on at the same time. "The Staff and Employés" toast was given by Mr. Councillor Edwards; Mr. D. Smith responded. Other toasts followed.

Tramway Officials.—The salary of Mr. A. J. Lauder, chief assistant in the Light Railways Department of the county engineer of Middlesex, is to be increased from £400 to £450 per annum.

General.—Mr. J. Arthur Reavell, for many years general manager of the Blake & Knowles Steam Pump Works, Ltd., and afterwards a director of the Worthington Pump Co., Ltd., has resigned his seat on the board of the latter company, consequent on his appointment as general manager to Messrs. Manlove Alliott and Co., Ltd., of Bloomsgrove Works, Nottingham. Mr. Reavell takes up his new duties on February 1st.

Obituary.—We regret to record the death of Prof. Sir Michael Foster, K.C.B., who was president of the British Association in 1899. He was born in 1836. It was in physiological science that he attained a position of great eminence and world-wide fame.

NEW COMPANIES REGISTERED.

Waste Heat and Gas Electrical Generating Stations, Ltd. (91,738).—This company was registered on January 19th, with a capital of £100,000 in £1 shares, to generate, store, transmit, purchase, supply and distribute electrical and other energy for motive power, light, heat or other purposes, to construct electrical power supply, electric light, telephone, telegraph, gas and other works, railways, tramways and other public and private works and conveniences, to apply for or procure the transfer of any Acts of Parliament, Provisional or other Orders and authorities, to carry on the business of electrical and general engineers, colliery owners, gas and coke manufacturers, dealers in electrical and other machinery and rolling stock, utilisers of and dealers in the waste products of and gases and waste heat from any works, coke ovens, furnaces or factories, &c. The first subscribers (each with one share) are:—J. N. Simpson, Bradley Hall, Wylam-on-Tyne; F. S. Newall, Castle Hill, Wylam-on-Tyne, gentleman; F. Priestman, Shotley Park, Shotley Bridge, colliery owner; H. Peile, Shotley Lodge, Shotley Bridge, colliery owner; J. Pumphrey, Minalu Acres, Riding Mill, colliery owner; J. F. Bottomley, 16, Manor House Road, Newcastle-on-Tyne, chemist; and H. W. J. Vertigan, 57, Meldon Terrace, Heaton, Newcastle-on-Tyne, clerk. No initial public issue. The number of directors is not to be less than three or more than seven; the subscribers are to appoint the first; qualification, £200; remuneration, £200 per annum, divisible, when the number does not exceed three, with a proportionate increase for any higher number.

South American Railway Construction Co., Ltd. (91,734).—This company was registered on January 19th, with a capital of £101,000 in 100,000 "A" shares of £1 each, and 20,000 "B" shares of 1s. each, to construct, lease or acquire, develop and control railways, tramways, electrical and other works, docks, harbours, piers, canals and other public works and conveniences in South America or elsewhere, to promote any company for the purpose of acquiring all or any of the assets and liabilities of this company or otherwise, &c. The first subscribers (each with one share) are:—J. Brown, 17, Gracechurch Street, E.C., accountant; W. G. H. Monypenny, 62, London Wall, E.C., merchant; D. J. Paterson, 53, New Broad Street, E.C., secretary; H. Bacon, 30, Mendova Road, Elm Park, S.W., secretary; H. G. Burbidge, 419, Strand, W.C., clerk; G. J. Philip, 150, Pomeroy Street, New Cross, S.E., costs draftsman; and F. H. Law, 7, Princes Square, Kennington Park Road, S.E., clerk. No initial public issue. The number of directors is not to be less than three or more than seven; the subscribers are to appoint the first; qualification, one share; remuneration, £250 each per annum (chairman £100 extra). Registered office, 17, Gracechurch Street, E.C.

Modern Traffic Development Corporation, Ltd. (91,692).—This company was registered on January 17th, with a capital of £1,000 in £1 shares, to carry on and exploit any method of propulsion by mechanical means or by forces of nature, on or under land or sea, or in the air, and to carry on the business of carriers, wharfingers, contractors, public and private conveyance proprietors, motor dealers and manufacturers, engineers, founders, &c. The first subscribers (each with one share) are:—E. A. Locock, 164, Colherne Court, S.W., gentleman; E. A. Bicknell, 32, Southampton Street, Strand, W.C., solicitor; J. K. Harris, 30, Yerbury Road, Holloway, N., dispenser; H. H. Lawson, 119, Finsbury Pavement, E.C., solicitor; Miss L. Hayward, 116, Eglinton Road, Plumstead; Mrs. M. B. Locock, 164, Colherne Court, S.W.; and R. A. B. Tyler, 27, Harold Road, Crouch End, N., clerk. No initial public issue. The number of directors is not to be more than three. E. A. Locock is the first director, with power to appoint other directors before the general meeting in 1908; qualification, £1; remuneration, £52 10s. each per annum. Registered office, 14 and 15, Bedford Chambers, Covent Garden, W.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Mansfield and District Tramways, Ltd. (91,130.)—A trust deed dated December 17th, 1906, to secure £70,000 debenture stock created by resolution of even date, has been registered. Property charged: 40,000 5 per cent. preference and 70,250 ordinary shares of £1 each, fully paid, and £37,000 4½ per cent. mortgage debentures or mortgages of the Mansfield and District Light Railway Co., and the company's undertaking and property, present and future, including uncalled capital. Trustees: Alliance Trust Co., Ltd., Dundee.

Chiswick Electricity Supply Corporation, Ltd. (38,854).—Issue on December 29th of £4,000 4½ per cent. debentures, part of series created by resolutions of November 2nd, 1900, and March 8th, 1901, to secure £50,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series: £37,500.

Electric Supply Corporation, Ltd. (London) (52,036).—A trust deed dated July 18th, 1904, originally securing £50,000 debenture stock, has been stamped to cover a further £50,000 authorised by resolution of December 6th, 1906. Property charged: The company's undertaking and property, present and future, including uncalled capital. Trustees: C. Fowell, Tufnell, Watendone Manor, Kenley, Surrey, and W. B. M. Bird, 58, Cadogan Place, S.W.

Maxim Electrical Co., Ltd. (London) (84,426).—Issue on November 30th of £9,000 5 per cent. debentures, part of series created by resolutions of May 16th and November 29th, 1906, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. No previous issue of same series. Registered January 7th, pursuant to order of Court.

Buller's, Ltd. (62,020).—This company's annual return was filed on December 21st, when 15,000 preference and 15,000 ordinary shares had been taken up out of a nominal capital of £400,000 in 20,000 ordinary and 20,000 preference shares of £10 each; £10 per share has been called up on 7 ordinary and 15,000 preference, resulting in the receipt of £150,070; £149,930 is considered as paid on 14,993 ordinary shares. Mortgages and charges: Nil.

British Eastern Electric Power Co., Ltd. (74,280).—This company's annual return was filed on January 4th, when the entire capital of £1,000 in £1 shares had been taken up and paid for in full. Mortgages and charges: Nil.

ELECTRIC TRAMWAY ACCOUNTS.

Glasgow Municipal Tramways.

The annual return of the Glasgow Corporation Tramways Department always makes interesting reading, and the year ending May, 1906, is no exception to the rule. From the figures given below it will be noted that the gross profit for the year shows a decrease of nearly £13,000 as compared with 1905; working expenses increasing by £69,102, whereas the total revenue increased by only £56,148. The revenue per car-mile increased by about ·2d., but the revenue per mile of route decreased. Working expenses per car-mile increased by ·62d., this being mainly due to extra cost of maintaining the permanent way.

During the 12 months under review some 6 miles 6 furlongs of new route were opened for traffic. The total route-miles of track owned by the Corporation amounts to 75 miles 2 furlongs, and the route-miles run over include 4 miles 2 furlongs belonging to the Govan Corporation, and about 1 mile of double track of the Paisley and District Tramways Co.'s system. In passing, it may be mentioned that the cross sleeper method of construction was adopted on all track extensions and renewals carried out during the year. The sum of £65,914 was expended in 1905-6 on the upkeep of the tramway track and in ordinary repairs, and, in addition to this sum, £75,584 has been laid aside out of the year's revenue to meet the cost of renewing the track; this sum being calculated at the rate of £500 per mile of single track. The number of cars in stock at May last, amounted to 783, and the cost of inspection and repairs to rolling stock throughout the year amounted to £30,687.

The capital expenditure at May 31st last totalled £2,971,349, of which sum £207,967 was expended on capital account during 1905-6. The amount of interest and sinking fund applied in redemption of debt was £296,132. The balance standing to the credit of depreciation and permanent way renewals fund was £905,254, made up as follows:—As at May, 1905, £777,637 plus £169,886 added from revenue during 1905-6, minus £42,270 expended during the year.

From the net balance of £56,418 remaining after meeting financial charges, &c., a special contribution of £10,000 has been appropriated for depreciation of buildings, and an additional payment of £10,000 has been made to the Common Good (making a total of £35,000 on the year), and leaving a balance of £36,418, which was carried to the reserve fund account. This sum, together with the previous balance on this account, totalled £69,023, but from this fund, during the 12 months, £29,581 was deducted for alteration of buildings, electrical plant, &c. Hence, the amount available for the balance-sheet was £39,442.

During the year 1,405,843 KW.-hr. were supplied to the Corporation electricity department, for which the tramways department received £4,515 after deducting its proportion of power expenses. The total KW.-hr. generated amounted to 26,339,628, and the percentage of loss between KW.-hr. delivered and used for all purposes was 10·65 per cent. The percentage loss in the previous year was 11·33 per cent. The maximum load was 8,033 KW., as against 8,517 KW. in 1904-5; the maximum load, however, on the traction bus-bars increased from 6,300 KW. in 1904-5 to 7,476 KW. in 1905-6. The traction load factor last year was 38·07 per cent, a slight drop on the previous year, but the load factor, when the supply to the electricity department is taken into account, was 37·4 per cent., against 30·8 per cent. in 1904-5.

On the output of 25,334,192 KW.-hr. the department's total power costs were as follows:—Generating costs amounted to ·283d. per KW.-hr., including fuel, ·113d.; the total costs, including rent, &c. insurance, general management (·058d.), depreciation (·336d.), and interest and sinking fund (·398d.), amounted to 1·075d. per KW.-hr.

The general manager is Mr. Jas. Dalrymple, and a report by him, on proposed extensions, will be found on page 186.

GENERAL STATEMENT.

For 12 months ending May 31st ...	1905.	1906.
Length of route	73¾ miles.	80½ miles.
Total length of track	144¼ „	160½ „
Average number of cars in use ...	448.59	517·9
Car-miles run	17,943,395	18,886,910
Passengers carried per annum... ...	195,767,519	208,059,833
Capital expended to date	£2,776,246	£2,971,349
Traffic receipts	£756,480	£813,768
Total receipts	£764,791	£820,939
Working expenses	£387,167	£456,269
Gross profit	£377,624	£364,670
Income per car-mile	10·23d.	10·43d.
Working expenses per car-mile ...	5·18d.	5·80d.
Interest and sinking fund per car-mile	1·30d.	1·31d.
Rental of leased lines	·08d.	·114d.
Total expenses per car-mile	6·56d.	7·22d.
Profit or loss per car-mile	3·67d.	3·20d.
Cost of energy per car-mile	·34d.	·346d.
Average fare per passenger	·93d.	·94d.
Average fare charged per mile ...	·46d.	·45d.
Revenue per mile of route	£10,335	£10,260
Expenditure per mile of route ...	£5,232	£5,703
Total units used	20,268,407	22,350,303
Units used per car-mile	1·13	1·18
Percentage of working ex'es to receipts	50·42%	55·26%

GENERAL STATEMENT, 1906.

Interest on capital	£54,787
Sinking fund...	48,327
Income-tax	12,423
Rental of Govan and Ibrox Tramways	5,089
Payment to Paisley and District Tramways Co.	4,627
Depreciation...	84,302
Permanent way renewals fund	75,584
Parliamentary expenses	2,858
Payment to common good in terms of arrangement	25 000
Net balance	56,418
	£369,415
Less interest on surplus revenue	4,745
Gross profit	£364,670

CITY NOTES.

Metropolitan Railway Co.

SIR CHAS. MCLAREN, in addressing the shareholders on 24th ult., referred to the increase in expenses on the Metropolitan; £7,500 of the increase was in respect of maintenance. The life of the steel rail on the electric system was very much less than it was under steam; indeed, they found the rails actually pared away by the wheels, and they had been obliged to relay many portions of their railway with rails of extraordinary hardness. That had added very much to their expense. The dividend was disappointing to both directors and shareholders, but the accounts presented the actual earnings of the line. They could not get more than the line actually earned, and they must be satisfied and hope for better results from the completion of their electric traction. Circumstances had very materially changed since they first determined to electrify their system. They did so in accordance with the wishes of their stockholders and upon pressure from the travelling public. They had completed that electrification, but since they came to that

decision the means of transit in London had increased enormously. That competition had adversely affected them, but they still believed that had they not carried out this electrification their position would have been very much worse than it was at the present moment. The reduction in their fares was necessary in order to meet the competition which existed. They had provided a more excellent accommodation, so much so that the majority of their passengers were now travelling third class instead of first. These changes had caused a falling off in revenue in the local traffic, but he was glad to tell them that between the actual stations where reduced fares had been put into operation the increase in the traffic had practically compensated them for the reductions made. It was a somewhat significant fact that their largest decreases had been upon the St. John's Wood and Hammersmith lines, where the fares had not been reduced at all. There were no steam trains now working on the tunnel section of the line north of Baker Street, and they were gradually getting the stations on that section cleaned up and whitewashed. He had been anxious to be able to say at this meeting that they had got rid of all steam on the Inner Circle, and although he could not go quite so far as that, he was in a position to tell them that the whole of the Inner Circle trains, the Hammersmith and City trains, and the Addison Road trains were now worked electrically, and that the only passenger trains now worked by steam on the Circle were three per day belonging to the Great Western Co. In a short time all the steam engines on these trains would disappear and the only steam trains left would be the Great Western goods trains worked at night after the passenger traffic was over. Their power house at Neasden was now working very well, and they were producing their current at as cheap a rate as it was produced anywhere in the country. It was only ·319d. per Board of Trade unit, and if they added to that the interest on capital, they were producing it at something like ·5d. per Board of Trade unit. The result of their claim against the Westinghouse Co. for failure to complete their power house according to contract time had resulted in their receiving £22,000 by way of compensation. The directors had resolved to carry this sum to reserve, because they were so much in the dark as to what the maintenance and depreciation charges on their electric plant and rolling stock would amount to. It was their intention to introduce a new system of signalling—one which would be quicker in its operation than the existing manual block working, and superior to those in use on other lines. It was also their intention to run through trains from the section north of Baker Street through to Moorgate Street and Aldgate. With regard to the motor-'bus competition, he said they had suffered in common with other lines. The traffics on the competing tubes had also been depleted, and that to a very large extent, by these vehicles. They could not help regarding that as a most unfair competition, inasmuch as the business was being in effect subsidised by the local authorities who made no charge to the omnibus companies for the use of the roads, nor in respect of rates, except in so far as their stabling was concerned.

Eastern Telegraph Co., Ltd.

The half-yearly meeting held on Wednesday last week was presided over by Sir J. Wolfe Barry, K.C.B., who, in proposing the adoption of the report (see Electrical Review, p. 157), said that the gross revenue for the half-year amounted to £557,500, as against, for the corresponding period of 1905, £607,700, or a decrease of £50,200. When he last had the pleasure of addressing them he dealt very fully with the reductions which had taken place in the traffic receipts with India, China and Japan, Egypt and South Africa. Those branches of the receipts were again responsible for the decrease in the revenue during the half-year which they were now considering. He was, however, pleased to record a steady improvement in the receipts from traffic with India, and the Egyptian receipts for the last quarter of 1906 had shown an increase over the revenue before the reduction of rates. The cessation of war between Russia and Japan accounted for the present falling off in the traffic receipts with the Far East, but they might perhaps look for an early improvement in this direction in view of the commercial activity which they hoped would prevail after so long a depression consequent upon the war. There was also a continued falling off in the receipts for messages to and from South Africa, so far as ordinary traffic was concerned, although the native rising in Natal last spring and summer was the cause of some increase in Government and Press traffic. On the other hand, the traffic with South America shows satisfactory improvement, due to the general growth of business, and in some degree to the extra messages carried during the period when other routes were disorganised, owing to the lamentable earthquake in Valparaiso. The ordinary expenses for the half-year amounted to £253,200, against, for the corresponding period to September 30th, 1905, £231,200, or an increase of £22,000. Of the increase, about £9,000 was due to the augmentation of the staff abroad, rendered necessary owing to the larger volume of work to be handled, to the automatic increases in the salaries, and to the fact that additional travelling expenses were incurred, on account of more members of the staff coming home on leave than in the corresponding period. Their contributions towards the expenses of other companies' stations where their cables were joined up, showed an increase of about £4,000, owing to a more rapid system of working the cables by the West Coast route, and to the laying of a new cable between Porthcurnow-Fayal and St. Vincent. The expenses attending maintenance of cables were about £8,000 more than in the corresponding half-year. That item of expenditure was, for obvious reasons, one that was very difficult to control, dependent as it was upon the extent of the repairs that might be necessary, the length of cable required to effect the various repairs, and the depths of water in which the work had from time to time to be done. During the last half-year their ships had been kept busy, and several repairs had necessitated the expenditure of longer lengths of cable than in those effected in the corresponding period of 1905. The amount earned for charter of ships to other companies was also considerably less this half-year than that received during the corresponding period last year. The increase of the ordinary working expenses was to be regretted, but as he had repeatedly stated on previous occasions, they had had to deal with a larger volume of traffic resulting from reduced tariffs. This was a serious factor, and was one which they were bound to face when such important reductions in the rates as those introduced in August, 1905, came up for consideration, in order to meet the demands of their customers and the public. He was glad to say that, although the ordinary working expenses had increased considerably since August, 1905, when the important reductions to which he had referred were made, the relative cost per word of handling the traffic had practically remained at the same figure—that was to say, the increase in the working expenses was in the same ratio to the number of words carried. They had been endeavouring for some years past to obtain a revision of the amount allowed by the authorities for depreciation of cables when assessing the company for income-tax, and they had now come to an arrangement which might be considered satisfactory, and which settled this vexed question for some years to come unless any drastic alteration were made in the income-tax law. As a result of the adjustment they had obtained a refund of some £22,000 in respect of the three years ended April 5th, 1906. It had been found advisable to alter the date of the company's financial year, which had hitherto been taken as ending at March 31st. That step had been found necessary owing to the great increase of work entailed by the extension of traffic arrangements with Government administrations and other telegraph companies, and the difficulty of receiving accounts from different parts of the world in time for their being checked and embodied in the accounts usually presented at the general meetings held in January and July. The directors had, therefore, decided to make up the accounts in future to June 30th and December 31st in each year, instead of September 30th and March 31st as formerly. The half-year's accounts to June 30th would be submitted to a general meeting to be held in November, and the final half-year's account to December 31st would be presented at a general meeting to be held in May. In order to give effect to these alterations the next accounts would be made up for the quarter ended December 31st, 1906, and presented at a general meeting to be held in May next, when the usual final dividend and bonus on the ordinary stock would be proposed and paid, instead of in July as formerly. The payment in May of the final dividend and bonus on the ordinary stock would take the place of the interim dividend usually paid about April 15th. Future interim dividends on the ordinary stock would be paid about the middle of July, October and January in each year. With regard to the dividends on the preference stock, they would be paid at the same dates as those on the ordinary stock. Under the circumstances of the above alterations they had made no contribution to the general reserve fund this half-year, but had carried the balance of £117,090 forward to next account, when the question as to a suitable contribution to the general reserve fund would be decided.

Sir J. Denison Pender seconded the motion, and the report was adopted.

City and South London Railway Co.

Mr. C. B. Stuart-Wortley, chairman, presided at the offices, Finsbury Pavement, on Tuesday, over the forty-fifth ordinary general meeting of the above company.

In moving the adoption of the report (see Electrical Review, page 157), the Chairman said that the half-year just closed showed an improvement all round compared with the corresponding period. They had carried more passengers per train and more passengers in all. They had run more trains, and made more money per train. They had run more train-miles, and had made more money per train-mile. The total receipts had increased by £2,408, and the expenses by only £888, and they were consequently able to propose a dividend at the rate of £2 per cent., against £1 15s., and to carry forward £2,521 against £1,367. A circumstance which made this result the more satisfactory was that they were able to pay the dividend notwithstanding that this half year they were paying as dividends on capital spent on the unfinished extensions to Euston—and therefore still unremunerative—the sum of £3,426. Excluding as usual season-ticket holders, the passengers carried showed an increase of 496,807, or an improvement which was approximately in the proportion of 17 to 18. The train-miles run were 552,048, against 546,992, and the locomotive charges per train-mile were 4·84d., against 4·65d. On the other hand, the traffic expenses per train-mile were 6·66d., against 6·79d., and the total expenses were 1s 3·53d., against 1s. 3·30d. per train-mile, and the receipts per train-mile 2s. 7·61d., against 2s. 6·9d. The season tickets were £4,131, against £4,422, and to this small extent they had been affected by the opening of other lines. The receipts per passenger were 1·79d., against 1·83d., and this was due to the fact that the Baker Street and Waterloo Railway had been opened, which had brought them a valuable increase of short-journey passengers. Under such circumstances, they did not mind finding that the average amount taken was less than it was formerly. Not merely from the south side, but even as a route to the City and West End this Bakerloo connection was not to be despised, for he himself had personally succeeded in getting from those offices to Trafalgar Square in 20 minutes, and from the Bank this time would be shortened by about 3 minutes. As part of the pro-

vision for the new line they issued £150,000 preference stock. The issue was made at a time when the market conditions were by no means favourable, but notwithstanding the stock was over subscribed to a considerable extent. The works for which that money was raised were in a forward state. For the Euston extension the tunnels were built and the rails laid, and while he could not give the date of the opening yet, he did not think they would have to go for more than 9 or 10 weeks' longer without some return for their outlay on this work. Reference was made in the report to negotiations for through bookings, and these were most important, for by their Euston line they were providing a new and direct route to the City, and also gave quick access from King's Cross, St. Pancras and Euston to the lines of the Brighton Co. and the London, Chatham and Dover Railway. At Euston also they gave accommodation for the passengers who would come by the new tube being constructed from Golder's Green and Hampstead. They were also justified in looking forward to a large amount of traffic from that source. There was another hopeful prospect for them in some remote future, and that was the contemplated new line from Watford to Euston promoted by the London and North-Western Railway Co. If Parliament passed the scheme it was proposed to have an underground line to London Road, and it was intended to open new stations at Kensal Green, Acton Common, Stourbridge Park, East Lane and Kenton. He hoped that in the information he had given them they would find that there was real vitality in their modest organisation, and that they had the power of adapting themselves to their environment, which was the surest sign of a vigorous constitution.

Mr. C. S. Grenfell seconded the motion.

Mr. Layton said that seeing they were connecting up these large railway termini, was it not possible to make some provision for carrying passengers' luggage? At present people were forced to take cabs owing to the difficulty of dealing with their luggage. He would also like to know in what form they were likely to issue any fresh capital.

Mr. Thompson asked if there was any excess on the estimates for the new lines.

Replying to these and other questions, the Chairman said the cost of the extension was approximately £500,000. He could not say whether the estimates would be exceeded until the work was completed. They had met with no unexpected accidents or disasters, and although there might be some small excess, he thought the cost would fairly approximate to the estimate. So far as the plans deposited by the L. & N. Western Railway for their projected lines were concerned, no provision was made for an interchange of running powers with their company, and he did not know if that would ever be done. He would ask them to trust the board with regard to further capital. They had unexhausted powers to issue both ordinary and preference stock, and also debentures, and they had to do the best they could for the proprietors, and make an issue on the most favourable terms possible. At present passengers could bring in luggage which they could carry, but the essence of their service was its quickness, and the difficulty was to know how to deal with luggage. It was a matter which the board were always considering.

The motion was carried, and a hearty vote of thanks was passed to the board and staff.

Bristol Tramways and Carriage Co., Ltd.

The directors' report to be presented at the meeting on Wednesday at Bristol, says that the gross receipts for the year ended December 31st, 1906, amounted to £266,769, and the working and general expenses and renewals were £176,461, leaving a net revenue of £90,307. The following amounts have already been distributed, viz.:—Interest on 4 per cent. mortgage debenture stock, and deposits, £12,492; dividend on 4 per cent. preference shares, £19,000; interim dividend at the rate of 8½ per cent. per annum (subject to income-tax), for the half-year ending June 30th, £20,188 = £51,679, and it is proposed to appropriate the balance as follows:—Final dividend for half-year at the rate of 9½ per cent. per annum (subject to income-tax), £22,563; addition to reserve fund for contingencies and renewals, £16,066. The interest on investments has been carried direct to the credit of the reserve fund for contingencies and renewals, and the values of the investments having been adjusted to market prices at December 31st last, the reserve fund then totalled £174,262. The company's investments have thus been increased by £12,857 during the past year, and with the addition now proposed will be further augmented to £190,328. The total number of passengers carried during the year on the company's cars and omnibuses was 46,902,257, an increase of 1,608,080 passengers. During the past year the construction of the tramway extension from the Horfield Barracks along the main North Road to Filton has been undertaken, and being now practically completed, will be opened for traffic next month. The company's services of motor-omnibuses have been worked on the various routes mentioned in the last report, and additional omnibuses are now in course of delivery, the number in stock or on order being 25.

Direct United States Cable Co., Ltd.

Sir James Pender presided at the half-yearly meeting held on Tuesday at Winchester House. In moving the adoption of the report (see Electrical Review, January 25th, page 157), he said that the revenue as compared with that of the corresponding period of 1905 showed an increase of £4,026, due to continued improvement in the traffic. It must be remembered in that connection that the revenue in 1905 had already shown a considerable increase upon that in 1904. The business was thus exhibiting satisfactory progressive development. With the increased burdens carried there had naturally been some increase in the expenses; extra duty had to be discharged by the staff, and additional stationery, &c., had to be provided. The increase of £588 in maintenance of buildings was largely accounted for by expenditure upon the renovation of the wooden cable station at Rye Beach, New Hampshire, which, after 30 years, required overhauling. It was now in a good state of repair, with improved sanitary and heating arrangements. Improved accommodation had also been secured in London at the head offices, without increase in rent. The reserve fund had been debited with £2,805 for maintenance of cables, and, on the other hand, had been credited with £8,326 for interest on investments. They had had a considerable period of satisfactory receipts, and had been very fortunate in having no serious break in their cable; both sections were in excellent electrical condition, and were working as well as they had ever done. Their traffic receipts continued to be satisfactory, and their relations with their partners in the pool left nothing to be desired.

Mr. Gunther seconded the motion, which was carried unanimously.

In responding to the usual vote of thanks, the Chairman said that the chairman, Mr. Underdown, was at present in Cuba, and Mr. Thomas Cochran, M.P., was in one of the other islands.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following to be quoted in the Official List:—

Baker Street and Waterloo Railway Co.—Further issue of £160,000 4 per cent. perpetual debenture stock.

City of Buenos Ayres Tramways Co. (1904), Ltd.—Further issue of 4,292 shares of £5 each, fully paid, Nos. 241,672 to 243,655 and 244,143 to 246,450.

Anglo-American Telegraph Co., Ltd.—The directors recommend the declaration of the following dividends for the year ended December 31st, 1906:—A balance dividend of £1 12s. 6d. per cent. upon the ordinary consolidated stock; a balance dividend of £1 10s. per cent. upon the preferred stock; a first and final dividend of £1 15s. per cent. upon the deferred stock; all payable on February 9th next, less income-tax. There will remain a balance of about £1,100 to be carried forward. The above dividends, together with those already paid, will amount to £3 17s. 6d. per cent. on the ordinary consolidated stock, £6 per cent. on the preferred stock, and £1 15s. per cent on the deferred stock for the year 1906. The total dividends for the year 1905 were:—£3 5s. per cent. on the ordinary consolidated stock, £6 per cent. on the preferred, and 10s. per cent. on the deferred. The meeting is to be held on February 8th.

St. James' and Pall Mall Electric Light Co., Ltd.—The directors recommend a dividend for the half-year ending December 31st of 5s. per share on the ordinary shares, making with the interim dividend paid on August 1st last a total distribution of 10 per cent. for the year. The dividend for the previous year was at the rate of 12½ per cent. per annum, and for 1904 at the rate of 14½ per cent.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended December 28th, 1906, was 302,501, compared with 237,062 units in the corresponding four weeks of 1905.

Blackpool and Fleetwood Tramroad Co., Ltd.—The directors have decided to pay a dividend for the half-year ending December 31st, 1906, at the rate of 9 per cent. per annum, placing £1,750 to the depreciation reserve, £500 to general reserve, and £600 to a special expenditure account, and carrying forward £2,202. The receipts for the half-year amounted to £24,536, against £20,623 in the corresponding half of 1905. During the half-year 320,000 more passengers were carried than in the corresponding period of last year.

Dublin and Lucan Electric Railway Co.—The accounts, after providing for debenture interest, show an available balance of £1,119, out of which the directors propose a payment of a 5 per cent. dividend on the preference shares, carrying forward £644.

Great Northern and City Railway Co. — The directors report that for the half-year ended December 31st the total revenue receipts amounted to £48,367, as against £45,711 for the corresponding period last year. The numbers of passengers carried for the same periods, excluding season-ticket holders, were 6,787,239 and 6,330,661 respectively.

Imperial Tramways Co.—The directors have declared a dividend at the rate of 10 per cent. per annum.

Westminster Electric Supply Corporation, Ltd.—A dividend at the rate of 13 per cent. per annum is recommended for the last half of 1906, making 12 per cent. for the year, as compared with a total of 13 per cent. for 1905.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	£*	No. of wks.	Total to date. £	£*	Route miles open. *
Aberdeen	Jan. 23	2,299	+ 63	33	49,378	+ 1,823	14·4 ..
†Ayr	„ 19	165	— 6	36	11,376	+ 86	8 ..
Bath	„ 26	1,241	— 71	4	2,524	— 92	13 ..
Belfast	„ 25	6,177	+ 419	4	12,444	+ 826	40 + 6½
Birkenhead	„ 27	1,855	— 76	43	45,554	+ 868	13·5 ..
Blackburn	„ 23	1,803	+ 123	43½	44,962	+ 2,830	13·6 ..
Blackpool Corp. ..	„ 23	616	+ 11	41	50,216	+ 3,635	11·87 ..
„ —Fleetw'd	„ 26	348	+ 26	3	684	+ 39	8·25 ..
Bolton	„ 27	3,766	+ 256	43	91,638	+ 7,246	26 + 1
Bournemouth ..	„ 23	2,483	— 170	42½	71,133	+10,148	21·5 +2½
Bradford	„ 19	8,075	+ 179	42	190,768	+ 7,288	58 + ·7
Brighton	„ 27	1,311	— 162	43	42,346	..	9·5 ..
Bristol	„ 25	8,992	— 358	..	..	..	28·5 ..
Brit. Elec. Trac. Co.							
Airdrie	„ 18	398	— 24	2½	565	— 21	3·65 ..
Barnsley	„ 18	289	..	„	364	+ 5	.. ..
Barrow	„ 18	393	+ 4	„	514	+ 20	5·37 ..
Cavehill	„ 18	95	+ 40	„	116	+ 45	.. ..
Devonport ..	„ 18	882	+ 40	„	1,164	+ 66	8·85 ..
Gateshead	„ 18	1,677	+ 4	„	2,217	+ 46	11·25 ..
Gravesend ..	„ 18	408	— 5	„	511	— 2	6·5 ..
Greenock	„ 18	1,023	— 74	„	1,372	— 91	7·25 ..
Hartlepool ..	„ 18	437	— 48	„	572	— 59	6·72 ..
Kidderminster ..	„ 18	169	— 17	„	213	— 21	.. ..
Leamington ..	„ 18	258	— 16	„	337	— 23	3 ..
Merthyr	„ 18	370	+ 24	„	462	+ 27	2·9 ..
‡Metropolitan ..	„ 18	7,567	+1,960	„	9,460	..	22 ..
Middleton	„ 18	568	— 1	„	702	— 3	8·5 ..
Mid. Joint Com'tee	„ 18	11,830	..	„	14,879	..	.. ..
Oldham — Ashton	„ 18	1,087	+ 72	„	1,371	+ 105	9·13 ..
Peterborough ..	„ 18	188	— 18	„	236	— 21	5·31 ..
Potteries	„ 18	3,570	— 17	„	4,472	+ 101	29 ..
Rothesay	„ 18	83	— 4	„	138	+ 6	2·75 ..
Southport	„ 18	390	— 43	„	..	— 60	8·17 ..
S. Metropolitan ..	„ 18	1,397	..	„	1,731	..	.. ..
Swansea	„ 18	1,572	+ 118	„	1,988	+ 129	5·5 ..
Tynemouth	„ 18	290	— 34	„	379	— 33	3·75 ..
Weston-s-Mare ..	„ 16	47	— 6	„	54	— 7	3 ..
‡Worcester	„ 18	466	— 30	„	603	— 43	5·75 ..
Wrexham	„ 18	175	— 2	„	224	— 10	.. ..
Yorks. Wool. Dist.	„ 18	1,776	+ 126	„	2,219	+ 200	17 ..
Miscellaneous ..	„ 18	341	— 31	„	434	— 33	.. ..
Burnley	„ 26	2,226	+ 134	..	..	..	7·5 ..
Burton-on-Trent ..	„ 27	477	— 53	43	12,287	— 509	10 + 1·5
Bury	„ 21	1,785	..	42	41,187	..	10·5 ..
Cardiff	„ 19	3,787	— 149	42	87,709	+ 1,312	15·87 ..
Carlisle	„ 26	251	— 60	4	571	— 82	.. ..
Chatham and Dist.	„ 24	1,183	— 9	4	2,138	— 19	12·84 + 3·6
Cork	„ 24	805	— 4	4	1,404	— 104	9·89 ..
Croydon	„ 25	2,285	— 87	34	49,422	+ 4,102	12 + ·75
Darlington	„ 26	172	— 13	43	9,062	+ 280	4·57 ..
Darwen	„ 25	461	— 19	43	10,983	+ 477	4·36 ..
Dover	„ 19	351	— 33	42	10,725	+ 1,140	4·75 ..
Dublin	„ 25	9,032	— 78	4	16,765	+ 69	51·25 + 1⅝
Dundee	„ 23	1,987	+ 100	34	40,052	+ 6,216	13 + ·5
East Ham	„ 26	1,520	— 92	43	38,721	+ 3,019	8 + ¼
Exeter	„ 25	463	+ 18	43	12,788	+ 468	4·75 + ·5
Glasgow	„ 26	31,906	+1,943	36	580,620	+48,571	86·75 +11
Hastings	„ 25	1,458	..	..	..	..	.. ..
Huddersfield ..	„ 26	2,461	+ 44	43	65,266	+ 5,605	28 ..
Hull	„ 26	4,455	+ 46	43	100,383	+ 4,044	13 ..
†Ilford	„ 26	766	— 41	43	20,573	+ 305	6·37 ..
Ilkeston	„ 23	224	+ 9	43	5,709	+ 621	3·5 ..
Ipswich	„ 26	608	— 26	43	18,355	— 82	10·5 ..
Isle of Thanet ..	„ 26	418	— 52	4	871	— 68	11 ..
Kilmarnock	„ 26	286	+ 18	37	5,925	+ 90	4·25 ..
†Kirkcaldy	Dec. 19	283	+ 33	..	..	..	7·5 ..
Lan'kshire Trm. Co.	Jan. 24	1,774	+ 211	4	3,298	+ 29	15·81 + 3½
Lancashire United	„ 23	2,021	+ 449	4	3,395	+ 778	37 + 9
Leeds	„ 19	11,684	+ 577	40	264,357	+16,265	96 + 14
Leicester	„ 26	3,772	— 148	..	..	..	.. ..
Leith	„ 19	927	+ 49	36	18,598	+ 5,810	6 + 1
†Liverpool	„ 12	10,728	+ 318	2	19,114	+ 758	104 + 1
‡L.C.C.	„ 12	26,188	+13,001	41	1,075,727	+471,504	114 +62½
London United ..	„ 25	9,839	+ 708	..	18,005	+ 1,037	.. ..
Lowestoft	„ 26	261	+ 15	17	2,757	+ 276	3·5 ..
Manchester	„ 26	26,004	+1,885	43	594,687	+42,680	146 +21
Newcastle	„ 26	7,488	+ 123	43	174,618	+11,375	25·5 ..
Newport	„ 19	1,066	— 39	4	26,653	+ 1,794	14·5 + 1·5
Northampton ..	„ 25	680	— 40	42	18,829	+ 441	5·5 ..
Oldham	„ 27	3,238	+ 155	44	78,948	+ 6,946	43·75 ..
Pontypridd	„ 26	293	+ 16	43	7,186	+ 852	3·5 ..
Portsmouth	„ 26	2,640	— 257	43	85,313	+ 687	14·5 ..
Preston	„ 23	1,280	+ 104	..	..	..	10 ..
Reading	„ 24	1,045	— 72	43	27,307	+ 408	7·5 ..
†Rochdale	„ 19	958	+ 153	..	..	..	20·6 ..
Rotherham	„ 24	963	+ 131	41	21,748	+ 2,109	10 + ·34
Salford	„ 21	8,555	+ 886	42	189,902	+ 6,280	38·9 ..
Sheffield	„ 27	10,134	+ 402	44	234,080	+16,896	35·75 + 1½
Southampton ..	„ 23	1,562	— 185	42	41,413	+ 185	.. ..
Southend-on-Sea ..	„ 23	476	— 17	43	17,183	+ 1,001	6 ..
Sunderland	„ 27	2,397	— 2	43	60,423	+ 3,184	10·87 ..
Swindon	„ 13	296	— 25	..	..	..	4·4 ..
Tyneside	„ 18	717	+ 66	4	1,169	+ 56	8·87 ..
†Walthamstow ..	„ 19	401	+ 54	42	24,423	..	9 ..
West Ham	„ 24	4,168	+ 319	43	97,142	+15,382	14·7 + 1·4
Wolverhampton ..	„ 23	1,544	..	42	36,237	+ 1,518	12·5 ..
Yorks. W. Riding ..	„ 27	1,848	+ 452	4	3,848	..	.. ..
Baker St.-Waterloo	„ 12	4,730	..	2	4,730	..	3·75 ..
Cen. London Rly. ..	„ 26	12,883	— 997	4	25,740	— 2,135	6 ..
City & S. Lon. Rly.	„ 27	6,214	+ 155	4	12,498	+ 244	6·25 ..
Dublin-Lucan Rly.	„ 25	172	— 2	4	315	— 13	7 ..
G.N. and City Rly.	„ 26	3,846	+ 68	4	7,681	+ 75	3·5 ..
G.N., P'dy. & Bromp.	„ 26	7,304	..	4	14,194	..	9 ..
L'pool Overh'd Rly.	„ 27	2,689	— 89	4	5,535	— 108	6·8 ..
Mersey Railway ..	„ 26	3,681	+ 209	4	7,346	+ 293	4·5 ..
Metropolitan Rly. ..	„ 27	31,211	..	4	62,859	..	70·5 ..
Met. District Rly. ..	„ 27	15,827	— 517	4	31,687	— 1,133	24 ..
Anglo-Argentine ..	„ 22	27,043	—1,301	4	51,844	+ 3,407	43 ..
§Auckland	Dec. 7	10,325	+ 430	49	119,887	+ 7,817	19·24 + ·6
§Brisbane	„	18,491	+1,031	..	..	..	.. ..
§Brit. Columbia Rly.	Nov.	20,034	+5,941	22	101,958	+18,188	.. ..
†Bu'n's A'r's E.T.Co.	Dec. 29	1,712	+ 265	31	73,851	+10,762	24 ..
Bu'n's A'r's-Blgr'no	Jan. 20	7,342	+ 498	..	10,869	+ 712	.. ..
Calcutta	„ 26	7,573	+1,828	..	..	..	.. ..
§Cape Electric T. Ld.	Nov.	14,396	..	..	..	..	.. ..
§Geneva	Dec.	7,206	..	..	..	..	.. ..
§Kalgoorlie, W.A. ..	„	4,457	..	52	51,118	..	20·5 ..
Madras	Jan. 15	1,150	+ 208	52	23,229‖	+ 2,806	12·75 +3·5
§Lisbon	Nov.	5,582	..	..	..	..	.. ..
§Mexico	Sep.	4,400	..	..	..	..	.. ..
Perth (W.A.) ..	Jan. 25	3,174	— 35	4	5,967	— 80	25·6 + ·37

Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.
‖ Total for the year 1906.

STOCKS AND SHARES.

Tuesday Evening.

This week's story is a somewhat colourless affair. There is the usual absence of business to play the villain, an unexpectedly good Anglo "A" dividend as hero, and Home Railway stocks as the persecuted good men. Of plot there is about as much as in many of the modern novels; it cannot even be said that the tale presents any particular "problem," nasty or otherwise.

It is the American Market which is now debited with imposing a check upon Stock Exchange activity. Financial difficulties connected with that department have cast a shade over various other sections, but it may well be doubted whether this particular cause has much to do with the lack of animation, say, in the markets with which we deal. Consols are lifeless, and they set the fashion to other investment constituencies.

Two startling falls occurred in the railway group. Metropolitan Consolidated has crumbled from 53½ to 48½, a drop of 5 points, following one of 4½ in the week before. Comfort of a chilly kind was conveyed in the report, but this had no effect in staying the slump, which some people think has gone almost far enough. In Underground Electric Railways notes, the fall has been even more severe, the price at 81 being 7 down on the week. Districts fell to 16, but recovered to their previous level of ½ more.

Glancing at some of the prior-charge stocks, Bakerloo Debenture stands at 95, Piccadilly Debenture at 89½, and Charing Cross Debenture at 86½. Central London Debenture is 106, and City and South London Debenture 105½, these five stocks bearing interest at 4 per cent.

The Central London dividend, giving all three Ordinary stocks 4 per cent., was quite as good as anyone had expected, and better than a great many looked for. But the stocks were unable to withstand the poor report and the prevailing depression in their own particular division, and the Ordinary at 80 is down a point. It now yields 5 per cent. on the money, and the Deferred pays but little short of 6 per cent., allowing for the fact that the price at the time of writing carries the full £4 dividend in it. Some of the railway prices will be *ex.* dividend this week, and the marking takes place between the day these notes are written, and the day upon which they appear in the glory of print.

For variety of fortune, the Anglo-American Telegraph Co. can vie with the most erratic. In 1903 the Deferred stock received a dividend of 2s. per cent., followed by nothing at all for 1904, 10s. for 1905, and now 35s. for 1906. The declaration last Friday caused a further advance in the price, but, of course, the real measure of improvement had all been discounted long ago. Thus it is that the stock shows a rise of no more than 2s. 6d., while the Ordinary advanced ½, and the Preferred 1¼. There are doubts expressed as to whether the company can maintain the rate, which is an exceptionally good one, out of the prosperity of an exceptionally good year. Direct United States shares at 15⅞ are ¼ lower, while a couple of Debenture stocks in the Eastern group are 1 up. Beyond these, the changes are *nil*.

National Telephone Deferred lost a point, and Oriental Telephone Preference at 1¼ are 1/16 better.

The St. James and Pall Mall declares a dividend of 5s. per share, making 10 per cent. for the year—a drop of 2½ per cent.—but no further change has taken place in the price, which remains at 9½. Lighting shares are steady as a whole. Charing Cross Preference fell another ⅛ to 4¼, and Hove shares came on offer, but there is rather a better tone in Edmundsons. This becomes apparent in the narrowing of the official quotations; the Ordinary are 2⅞ and the Preference 4¼ middle. South London Ordinary rose ⅛ to 3⅛.

Amongst the traction issues, British Electrics continue to shrink; the Ordinary are decidedly flat at 3½, the Preference being 7½, and both Debenture stocks a point lower. This fall is still due, in a great degree, to apprehension of the interim statement. Anglo-Argentine trams have not altered, but Belgranos are ⅛ up at 3⅞. Buenos Ayres Grand National shares, which are not quoted in the Stock Exchange List, are 4¼ for the Preference and 3 1/16 for the Ordinary. There seems to be much mystery surrounding the possible terms of agreement which are being discussed between some of these Argentine tramway undertakings. Metropolitan Electric Tramways Deferred have put on a few pence at 3s. 9d.

The only changes amongst the miscellaneous issues are a two point rise in Willans & Robinson Debenture, and an improvement of ½ in Henley's Debenture, making the prices 79½ and 108 respectively.

A Tangye Memorial.—The City of Birmingham has resolved to establish a memorial to permanently commemorate the services rendered by the late Sir Richard Tangye, and his brother, Mr. George Tangye.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share, †	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Jan. 22nd.	Closing Quotations Jan. 29th.	Business done week ended Jan. 29th, 1907. Highest	Lowest.	Rise + or Fall −	Present Yield per cent.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	8 — 8½	8 — 8½	..	..	..	£ s. d. Nil
149 600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	88 — 91	88 — 91	..	..	..	5 9 11
660,660	Anglo-American Telegraph	Stock	6½.	2¾%	3½%	3½%	78 — 70	68½— 70½	..	..	+ ½	5 9 11
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5½%	6 %	6 %	111 —112	112 —113	112½	111¾	+1	5 6 2
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	½%	1¾%	27½ — 27¾	27⅝— 27¾	28¾	27⅝	+ ⅛	6 6 2
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	..	101 —103	101 —103	..	..	..	4 17 1
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	..	6⅞— 7⅛xd	6⅞— 7⅛	..	..	..	5 10 4
2,097,680	Commercial Cable Stng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96¾ — 98⅛	96¾ — 98⅛	97⅛	..	..	4 1 3
16,000	Cuba Telegraph	10	0 %	5 %	5 %	..	8½ — 9	8¾ — 9	8⅞	8½	..	5 11 1
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	..	17 — 18	17 — 18	16⅛	15½	..	5 11 1
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	8⅜ — 8⅝	8⅜ — 8⅝	..	..	..	5 8 6
6,000	Do. do. 10 % Cum. Pref. ..	10	10 %	10 %	10 %	..	9 — 9½	9 — 9½	..	..	..	5 5 3
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
60,710	Direct United States Cable	20	8 %	8½%	4½%	..	16⅜ — 16½xd	15½— 16 xd	15⅝	15⅛	— ½	5 6 3
60,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
4,700,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	137 —142 xd	137 —142	140½	138⅜	..	4 18 7
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	..	86 — 88 xd	86 — 88	87⅜	..	..	3 19 7
1,596,765	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	..	105½ —107½	105½ —107½	106⅜	..	..	3 14 5
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	..	13½ — 13⅝xd	13½ — 13⅝	13⅝	13⅞	..	5 1 10
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	..	106½ —108½	106½ —108½	..	..	..	3 12 9
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	..	100 —102	101 —103	..	..	+1	3 17 8
200,000‖	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	..	99 —101	100 —102	..	..	+1	3 18 5
181,127	Globe Telegraph and Trust	10	5½%	5½%	5½%	..	10½— 10⅝	10½— 10⅝	10¹¹/₁₆	..	..	5 2 4
181,127	Do. do. 6 % Pref	10	6 %	6 %	6 %	..	14 — 14½	14 — 14½	14⅛	..	..	4 2 9
160,000	Great Northern Telegraph, of Copenhagen ..	10	15 %	24 %	24%	..	37½ — 39½	37½ — 39½	38⅜	..	..	6 6 6
33,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
17,000	Indo-European Telegraph	25	10 %	18 %	13 %	..	58 — 60	58 — 60	59½	53¾	..	5 8 4
226,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	⅞— 1	⅞— 1	18/1½	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	..	1 — 1⅛	1 — 1⅛	..	..	..	4 8 11
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	1²⁹/₃₂— 1³¹/₃₂	1²⁹/₃₂— 1³¹/₃₂	..	..	..	4 16 5
2 225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	..	110 —112	109 —111	110⅝	109½	—1	5 8 1
2 225 000	Do. do. Def. Stock	100	5 %	5 %	5 %	..	110½ —112½	110½ —112½	111¾	..	..	4 8 11
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	..	11 — 13	11 — 13	12½	11¾	..	4 12 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	..	10 — 12	10 — 12	10⅜	..	..	5 0 0
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	..	5½ — 5⅝	5½ — 5⅝	..	..	..	4 6 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	96 — 98	96 — 98	97⅜	96⅜	..	3 11 5
1,689,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —102	100 —102	101⅜	..	..	3 18 5
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6¾%	6¾%	7½%	..	1¹⁵/₁₆— 1¹⁷/₁₆	1¹⁵/₁₆— 1¹⁷/₁₆	..	..	..	5 4 4
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1⅛ — 1¼	1⅛ — 1¼	..	..	+⅛	4 11 5
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	98 —101½	98½ —101½	..	..	..	3 18 10
11,889‖	Reuter's	8	6 %	6 %	6 %	..	7⅞— 8	7⅞— 8	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
3,167	Submarine Cables Trust	Certs.	6 %	6 %	6 %	6 %	126 —129	126 —129	..	..	..	4 13 0
80,000	United River Plate Telephone	5	8 %	8 %	8 %	..	6⅞— 7⅛	6⅞— 7⅛	6¾	..	..	5 7 7
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	5⅝— 5⅞	5⅝— 5⅞	5¹¹/₁₆	..	..	4 11 11
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	108 —111	108 —111	..	..	..	4 10 1
15,609‖	West African Telegraph, Shares	10	4 %	4½%	4 %	..	10 — 10½	10 — 10½	..	..	..	3 16 2
80,008	W. Coast of America, 1 to 80,000 & 88,001 to 88,008	2½	Nil	Nil	Nil	..	⅜— ½	⅜— ½	..	..	..	Nil
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
207,980	Western Telegraph, Ltd., Nos. 1 to 207,980 ..	10	7 %	7 %	7 %	..	13½ — 14½	13⅜ — 14½	14¹/₁₆	13⅝	..	4 18 3
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101 —104	99 —102	103½	..	—2	3 18 5
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅝— ⅞	⅝— ⅞	..	..	..	Nil
34,568	Do. do. 6 % Cum. 1st Pref.	10	7 %*	6 %	5 %	..	7 — 7½	7 — 7½	..	..	..	6 13 4
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	5⅞— 6⅛	5⅞— 6⅛	..	..	..	Nil
80,000‖	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	59 —102	99—102	..	..	..	4 18 0

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	£ 5	..	8 %	8 %	..	7⅞— 8⅛	7⅞— 8⅛	8⅛	7⅞	..	4 18 6
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	5½%	5½%	5½%	5½%	5¹¹/₁₆— 5¹³/₁₆	5¹¹/₁₆— 5¹³/₁₆	5¾	5⅝	..	4 5 5
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	136 —139	136 —139	..	..	..	4 6 4
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	108 —106	103 —106	106	..	..	4 14 4
830,000	Babcock & Wilcox, 1 to 830,000	1	17 %	20 %	20 %	..	3¾— 4¼	3¾— 4¼	81/10½	..	..	4 14 0
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	..	1⅞— 1⅞	1⅞— 1⅞	..	..	..	3 15 7
88,000	British Aluminium, Ord., 2,001 to 40,000 ..	5	..	7 %	7 %	..	6 — 6½	6 — 6½	6⅞	6⅛	..	5 12 0
40,000	Do. do. 7 % Cum. Pref...	5	Nil	7 %	7 %	..	6¼— 6½	6¼— 6½	6¹/₁₆	6¹/₁₆	..	5 3 8
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	..	5¼— 5½	5¼— 5½	..	..	..	5 4 4
90,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	..	4 — 4¼	4 — 4¼	..	..	..	4 8 11
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	..	101 —105	101 —105	..	..	..	4 15 3
800,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	100 —103	100 —103	..	..	..	5 6 10
400,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	6 %	..	130 —135	130 —135	99½	..	..	4 8 11
800,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	..	110 —114	110 —114	..	..	..	4 7 9
800,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	106 —110 xd	106 —110	..	..	..	4 10 11
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
920,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	101 —104 xd	101 —104	..	..	..	4 6 7
188,801	British Electric Traction	10	6 %	6 %	3 %	..	3¾— 4⅛	3½— 3⅝	80/-	70/-	— ⅝	8 0 0
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	7⅛— 8	7¼— 7⅝	7⅞	7⅛	— ¼	7 14 10
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	108 —110	107 —110	108¾	108	—1	4 10 11
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	..	86 — 89	85 — 88	86	..	—1	5 2 3
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	..	6¾— 7	6¾— 7	..	..	..	5 14 3
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	6⅝— 6¾	6⅝— 6¾	..	..	..	4 16 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	102⅝	101⅜	..	4 7 5
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	..	94 — 98	94 — 98	..	..	..	4 11 10
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1⅜— 1⅝	1⅜— 1⅝	30/-	..	..	Nil
,016,858	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	71 — 75	71 — 75	..	..	..	5 6 8
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅝— ¾	⅝— ¾	..	..	..	Nil
50,000	¶ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	£	Nil	Nil	2½%	..	¹³/₁₆— 1	¹³/₁₆— 1	..	..	+ ¹/₃₂	5 0 0
160,000	Do. Non-cum. 6 % Pref. ..	£	6 %	6 %	6 %	..	1¼— 1⅝	1⅛— 1⅜	..	..	..	8 14 7
195,000‖	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	95 — 97	95 — 97	..	..	..	4 12 4
195,000‖	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	80 — 83	80 — 83	..	..	..	5 8 5
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	5 %	4 %	3 %	..	3⅜— 3⅝	3½— 4	75/-	70/-	+ ⅛	3 15 0
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	..	5¼— 5⅝	5¼— 5⅝	5¹¹/₁₆	..	..	5 11 8
27,500	Do "B" do. 1 to 27,500	5	6 %	6 %	6 %	..	5 — 5⅜	5 — 5⅜	5¹¹/₁₆	..	..	5 14 3
18,200	Do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	104 —106	104 —106	..	..	..	4 14 4
190,000	Do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	101 —104	101 —104	101	..	..	4 16 2
105,000	Calcutta Trams., 1 to 105,000	5	6 %	8 %	8 %	..	8¼— 8⅝	8¼— 8⅝	8¼	..	..	4 18 6
32,610	Do. 105,001 to 137,610	5	..	..	8 %	..	7⅝— 8⅛	7⅝— 8⅛	..	..	..	4 15 6
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,330	5	..	..	5 %	5 %	5¾— 6¼	5¾— 5¾	5¹¹/₁₆	..	..	4 6 11
850,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	103 —106	103 —106	105½	..	..	4 4 11
85,000	Callender's Cable Construction shares	5	12½%	12½%	15%	..	9¾ — 10⅛	9¾ — 10⅛	9⅝	..	..	7 3 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5⅝— 5⅞	5⅝— 5⅞	..	..	..	4 6 11
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —108	106 —108	..	..	..	4 3 4
491,229	Cape E. Trams., 1 to 491,229	1	10 %	6 %	Nil	..	⁷/₁₆— ⁹/₁₆	⁷/₁₆— ⁹/₁₆	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	..	1⅛ — 1¼	1⅛ — 1¼	..	..	..	5 1 1
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	97 —102	97 —102	100	..	..	4 8 8
911,566	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	80 — 82	79 — 81	81	79⅜	—1	4 18 9
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..	4 0 10
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	70 — 73	70 — 73	70¾	..	..	5 9 7
1,480,000	City and South London Railway	Stock	2½%	2½%	1¾%	2¼%	43 — 45	43 — 45	45	43¾	..	4 14 5
86,000	Crompton & Co., Nos. 1 to 86,000	£	2½%	2½%	2½%	..	1¹⁵/₁₆— 2¹/₁₆	1¹⁵/₁₆— 2¹/₁₆	42/3	41/3	— ¹/₁₆	3 12 9
100,000‖	Do. 6 % 1st Mort. Reg. Debs., 1 to [illegible] and 601 to 11,000 of 450 Red.	..	5 %	5 %	5 %	5 %	94 — 97	94 — 97	..	..	..	5 3 1

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated, all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued)*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Jan. 22nd.	Closing Quotations Jan. 29th.	Business done week ended Jan. 29th, 1907.		Rise + or Fall—	Present Yield per cent.
		†	1903.	1904.	1905.	1906.			Highest	Lowest.		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	..	1 7/16 — 1 11/16	1 7/16 — 1 11/16	..	..	..	5 18 6
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½%	6 %	6 %	..	14 — 15	14 — 15	..	..	..	4 0 0
59,987	Do. 6% Pref. between 1 and 60,000	10	6 %	6 %	6 %	..	14 — 15	14 — 15	..	..	..	4 0 0
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	2½%	4½%	..	1 1/8 — 1 3/8	1 1/8 — 1 3/8	..	..	..	8 6 9
17,189	Do. "A" shares, 01—017,189	5	Nil	2½%	4½%	..	2 1/4 — 2 3/4	2 1/4 — 2 3/4	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	85 — 87	85 — 87	..	..	..	4 14 0
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..	5 5 3
112,100	Electric Construction 1 to 112,100	2	4 %	Nil	Nil	..	1/2 — 7/8	1/2 — 7/8	..	..	..	Nil
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	7 %	7 %	7 %	..	1 1/2 — 2 1/8	1 1/2 — 2	..	..	..	7 0 0
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	81 — 84 xd	81 — 84 xd	..	..	..	4 15 3
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	8 5/8 — 9 1/8	8 7/8 — 9 1/8	..	..	..	5 2 4
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	94 — 97	94 — 97	..	..	..	4 2 6
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	3 %	4 %	4 %	4 %	32 — 33	32 — 33	66/3	..	..	11 18 9
96,000	Greenwood & Batley 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10 — 10½	10½ — 10¾	..	..	+ ¼	6 10 3
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	99 -101	102 —103	..	..	+2½	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	..	11¾ — 12¼	11¾ — 12¼	12	11¾	..	6 8 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	..	5 3/16 — 5 5/16	5 3/16 — 5 5/16	5⅜	..	..	4 0 11
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	106½—108½	107 —109	108½	..	+ ½	4 2 7
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10%	5 %	10%	10 %	15½ — 16½	15½ — 16½	15⅝	15 3/16	..	6 1 3
87,500	†Liverpool Overhead Railway, Ord.	10	12½	11½	Nil	Nil	1½ — 1¾	1½ — 1¾	..	..	..	Nil
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6 — 7	6 — 7	..	..	..	7 2 10
600,070	London United Trams (1901), 1 to 50,007	10	8 %	6 %	8 %	..	7¾ — 8	7 — 8	..	..	— ¼	3 15 6
899,980	Do. do. 60,008 to 100,000 (£6 paid)	10	8 %	6 %	8 %	..	3¾ — 4¼	3 — 3½	..	..	— ¼	5 2 2
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	8¼ — 9¼	8½ — 9¼	8⅝	..	..	5 5 3
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	86 — 91	88 — 91	..	..	+1	4 7 11
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	..	1/8 — 3/16	3/32 — 3/32	4/-	3/3	+ 1/32	Nil
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	..	27/32 — 31/32	27/32 — 31/32	19/4½	18/6	.	5 3 11
350,000	Do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	95 — 98	96 — 99	98	97½	+1	4 10 11
30,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	6 %	6 %	6 %	4 3/8 — 4 13/16	4 3/8 — 4 13/16	..	..	..	6 10 8
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	5 %	5 %	4 %	..	6 — 7	6 — 7	..	..	..	5 14 4
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	5 %	5 %	5 %	..	7 — 8	7 — 8	..	..	..	6 5 0
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	..	98½—101½	98½ —101½	99⅜	99	..	4 8 8
37,850	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	..	30 — 32	30 — 32	31½	30	..	5 16 3
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	87 — 89	80 — 82	86⅜	84	—7	6 1 11
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1½ — 2	1½ — 2	37/6	..	..	Nil
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3½ — 4	3½ — 4	73/9	..	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	75 — 80	77 — 82	80	78½	+2	4 17 7

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	5 %	5⅛%	5⅛%	..	5 — 5⅛	5 — 5⅛	..	..	..	5 0 0
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	..	8 — 9	8 — 9	8	..	..	5 11 1
10,502	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	7⅛ — 8	7⅛ — 8	7⅛	..	..	4 7 6
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	..	101 —104	100 —103	..	..	—1	3 17 8
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	..	3¾ — 4¼	3¾ — 4¼	71/3	..	..	5 17 8
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	..	4¼ — 4⅝	4 — 4⅜	..	..	— ⅛	5 0 0
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3¾ — 4	3¾ — 4	..	..	..	5 12 6
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
49,436	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	..	5 — 5⅛	5 — 5⅛	5 1/16	..	..	5 9 1
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	104 —107	104 —107	..	..	..	4 4 1
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	..	9¾ — 10¼	9¾ — 10¼	10⅜	10 5/16	..	5 14 3
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	..	11¼ — 12¼	11¼ — 12¼	12⅛	12	..	4 18 6
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	121 —124	121 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
40,000	County of Durham Electrical Power, Ord.	4	4 %	£8 7 0	4 %	..	3½ — 4⅜	3½ — 4⅜	..	..	..	3 16 2
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	..	4⅜ — 5¼	4⅜ — 5¼	..	..	..	4 15 3
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	..	8¼ — 9¼	8¾ — 9¼	8⅝	..	..	5 8 1
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	..	10¾ — 11⅛	10⅜ — 11⅛	11¼	11	..	5 4 4
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	105 —108	105 —108	..	..	..	4 3 4
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	..	2 — 3	2½ — 2⅝	48/9	42/6	— ½	7 12 5
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	3⅝ — 4⅜	4 — 4½	..	..	..	6 13 4
350,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	93 — 97 xd	93 — 97	..	..	..	4 12 9
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..	4 17 9
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	..	4⅛ — 5⅜	4⅛ — 5⅜	..	..	..	4 13 0
90,000	Do. 4½ % 1st. Deb. Stock	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	..	7⅜ — 8¼	7⅜ — 8	..	..	— ¼	5 12 6
21,000	Kensington and Knightsbridge Electric Ord.	5	12½	12 %	10 %	..	9¼ — 10¼	9¼ — 10¼	..	..	..	4 17 7
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	..	99 —102	99 —102	99	..	..	3 18 5
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	..	2 — 2½	2 — 2⅜	..	..	..	4 17 0
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	..	4⅜ — 5¼	4⅜ — 5¼	5 1/16	..	..	3 14 3
874,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	95 — 98	95 — 98	96	95½	..	4 1 8
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8½%	10 %	10 %	..	7⅜ — 8¼	7⅜ — 8¼	8	..	..	5 17 8
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	5⅜ — 5⅝	5⅜ — 5⅝	..	..	..	4 3 9
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	106 —110	106 —110	..	..	..	4 1 10
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	94 — 96	94 — 96	..	..	..	3 12 11
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	97 —100	97 —100	..	..	..	4 10 0
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	..	7⅞ — 8	7⅞ — 8	..	..	..	5 0 0
75,000	Do. 5 % Pref., 1 to 75,000	5	5%	5 %	5 %	..	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..	4 1 8
16,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	..	13 — 14	13 — 14	..	..	..	5 7 2
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	..	97 —100	97 —100	..	..	..	4 0 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6¼%	7 %	7 %	..	6 — 6½	6 — 6½	6½	6 5/16	..	5 7 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	96 — 98 xd	96 — 98	..	..	..	4 1 8
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	9 — 10	9 — 10	..	..	..	6 5 0
20,000	Do. do. 7 % Pref. 20,021 to 40,020	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	7½	..	..	4 7 6
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	94 — 96	94 — 96	..	..	..	3 12 11
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	..	1½ — 2½	1½ — 2½	40/-	..	..	8 0 0
60,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	..	73 — 77	73 — 77	..	..	..	5 3 11
65,000	South London Electricity Supply, Ord.	5	8 %	4 %	4 %	..	2⅜ — 3⅛	2⅞ — 3⅛	63/-	61/10½	+ ⅛	5 18 6
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	..	3/8 — 3/4	3/8 — 3/4	..	..	..	3 6 8
117,968	Do. Do. 7 % Pref.	1	7 %	7 %	7 %	..	1¼ — 1⅜	1¼ — 1⅜	26/3	26/-	..	5 1 10
200,000	Do. Do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	2⅜ — 3⅜	2⅜ — 3⅜	..	..	..	6 13 4
60,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	4 — 4½	4 — 4½	..	..	..	5 11 1
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	4½%	4½%	..	99 —102	99 —102	100½	..	..	4 8 3
110,000	Westminster Electric Supply, Ord.	5	18½%	14 %	13 %	..	9 — 10	9 — 10	9⅜	..	..	6 10 0
81,279	Do do. 4½ % Cum. Pref. (Originally 5%—Red. to 4½ % from 31st Dec., 1905.	5	5 %	5 %	5 %	4½%	5⅛ — 5⅜	5⅛ — 5⅜	5⅜	5⅜	..	3 18 3

Shares not officially quoted:—Mackay Companies, ord., 74—76. Pref. 72—74.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

Bank rate of discount 5 per cent. January 17th. 1907.

LIMITATIONS OF SUCTION GAS PLANT.

By AN ENGINEER.

The first considerations which are involved in regard to the relative advantages of any system of power supply, and which take precedence of all others, are :—

1. Freedom from danger to life and limb.
2. Suitability for the purpose in view.
3. Reliability.
4. Total running costs.

The following case practically shows that the suction gas plant not only satisfies the above conditions, but also others constituting details of these four primary items.

The *Gas and Oil Engine Record*, September 15th, 1906, gives an instance where the proprietor of a village sawmill, who became dissatisfied with his steam plant, purchased a gas engine and suction plant.

The erection of the new installation was carried out entirely by the purchaser and his son, without any form of skilled help. An expert from the *Gas and Oil Engine Record* was called in to inspect the plant and start the engine, but only slight adjustment of a few details was required, and the engine was set to work within one hour.

The plant was then tested both by varying loads and by stoppages, with most satisfactory results. The plant continued to run well for two days, but on the third it could not be started ; instead of applying for skilled help the proprietor thought that possibly he had failed to notice some small point which he should have attended to, so before trying to start on the Monday morning he carefully cleaned the ignition plug and warmed it, when the engine started without the least trouble. "This was more than two years ago, and we believe we are correct in saying that up to the time of writing neither the engine nor plant has received any attention from anybody except the proprietor himself."

Though the owner was without previous experience of any kind of internal combustion engine, he had been able to erect and keep a 20-h.p. plant in constant operation for the period stated, without any expense for skilled labour. These facts would go a long way to show that with reasonable care freedom from danger can be assured ; the suitability of the installation for the purposes of a sawmill, with its extremely variable load, was shown by the fact that more work was put upon the engine than had ever been attempted with the steam engine, while the gas engine was unaffected ; reliability was evidenced by the constant running for over two years without requiring any skilled assistance.

The absence of particulars of the relative cost compared with the dismantled steam plant prevents a comparison in this instance, but the low cost of suction gas power is well known to rival that of any but the largest and most expensively equipped steam installation.

In regard to skilled attendance for gas engines and gas producers of the suction type, the writer's personal experience has on several occasions proved that an intelligent labourer, without any previous knowledge of either steam or gas engines, makes the best class of attendant provided he is instructed upon a few necessary details.

As an instance, in the case of a gas engine working on blast furnace gas, the leading hand from the manufacturers' shop was first put in charge ; upon his proving unsatisfactory a man was selected from the testing department of a firm of gas engine makers, but with no better results ; later, two labourers were selected, both entirely without previous experience—one for the day turn and one for the night turn —and this arrangement proved highly satisfactory.

To give another instance, a fitter who had only had experience with a suction gas plant and gas engine during about three eight-hour trials, and a few shorter runs, accompanied a suction gas installation to a foreign destination, erected and started it, without the least trouble. As showing the small amount of labour required, one man can easily take charge of two plants of 160 h.p. capacity each, even though they are 50 yds. apart.*

In regard to danger from explosion, the writer is aware of accidents of this kind happening where the results might have been serious, but would point out that if each part of the apparatus is proportioned in strength to the capacity for explosive mixture, there is not the slightest danger from an occasional explosion ; in all the plants of which the writer has had experience the only possible result of an explosion has been the blowing of some of the water out of the seals. Only badly designed apparatus can be a source of danger from any explosion that may by carelessness or accident occur in any part of an installation on the suction principle.

The advantages of the suction gas producer over producers working under pressure do not to any extent apply to the quality or quantity of gas made, but are chiefly due to the simplicity and low capital cost of the apparatus, through the dispensing with any storage gas holder and steam boiler, as well as to the small floor space required. For gas plants below about 100 h.p. on the pressure system, the necessity for a gas holder and steam boiler renders the initial cost high in proportion to the power, while the room occupied by the installation is an obstacle in many places where there is little available space.

A suction gas plant is so compact, and consists of such a small number of parts coupled with low first cost, that it becomes available as an economical source of power for requirements as low as 4 h.p., many firms including this size as their smallest standard type. For such small power requirements as 4 to 6 h.p., which usually only work for not more than eight or nine hours per day, a suction plant and gas engine would have many advantages, especially from an economical point of view, over a steam boiler and engine, but where electricity or lighting gas is available, even though the total cost of suction producer gas might be lower than the cost of electrical energy or illuminating gas, there are other advantages accruing from the use of these latter sources of power. In those areas where a reduced rate is allowed for electrical energy when used for power purposes, and motors are let out on hire, with, as in some cases, a skilled attendant to call periodically to lubricate and inspect the motor, in the entire absence of any capital cost, charges for an attendant, or, indeed, any charges other than that for the actual energy consumed and hire of motor, the advantages are in favour of electricity ; it being simply a matter of turning a switch when the power is required, and again when the call for power ceases, there being no stand-by charges whatever.

With illuminating gas and a gas engine, also, in the case of small powers, the greater economy of the suction plant may be discounted by the advantages offered by the supply of rich, pure gas available for use at any moment, and free from stand-by charges.

Where a supply of fuel, either anthracite or coke, can be obtained at a suitable price and of regular quality, a brake-horse-power-hour can be developed by a gross weight of fuel at full load of about 1·1 lb. of anthracite or 1·3 lb. of coke, the amount varying slightly with different designs of generators, while there is also a difference in the proportion of water required, as, for scrubbers, from 1½ gal. per B.H.P.-hour to 5½ gal. per B.H.P.-hour, and for the vaporiser, for providing steam for the generator, from 0·1 gal. per B.H.P.-hour to ·5 gal. per B.H.P.-hour, so that the selection of a suction producer for any special locality should be governed by the cost of the available supply of fuel and water.

The efficiency of the cleaning apparatus for the gas leaving the generating chamber will determine the periods at which it is necessary to clean the valves and combustion chamber of the engine, while the capacity of the cleaning vessels will have an influence in increasing or decreasing the quantity of water to be passed through them.

In any case it is preferable to have the scrubbers of small sectional area with ample length of passage for the gas, rather than short vessels of large diameter, owing to the suction action of the engine piston not having a tendency to cause the gas to fill the vessels, as is the case when the system is worked under a plenum.

It is important to bear in mind that in the suction system the flow of air, steam and gas will, in all the vessels employed, take the course of least resistance.

Having touched upon the minimum limitations of the suction producer, we may now turn to those of the maximum.

* Mr. Hugh Campbell, in a lecture before the Huddersfield Engineering Society.

Though there are no records up to the present of any very large suction gas power installation, the application of the system is practically unlimited, provided that a constant supply of suitable fuel can be obtained at a cost low enough to compete with any other power supply in the locality, for when the proportions of fire grate, &c., become too large in a single generator, a number of producers can be employed. However, where more than two or more engines are coupled up to one or more gas producers, careful consideration must be given to the disposition of the various items to prevent one engine from drawing off the supply of gas in such a manner as to rob the others.

In the trials of suction gas plants at the Royal Agricultural Society's Show at Derby last year, it was found that the maximum B.H.P. per sq. ft. of gas generating chamber area was 31 B.H.P., but the average was 24·3 B.H.P., the average cubic capacity being at the same time 8·7 cb. ft.

Mr. S. F. Saeger, in a paper read before the Michigan Engineering Society, says that the Pintsch suction producer has been built in single units up to 2,000 H.P., on the same lines as the smaller ones, and these have worked with perfect success, while the consumption of fuel slightly decreases in the larger powers.

In regard to the efficiency of the cleaning apparatus employed in conjunction with the Pintsch producer, an instance is cited by Mr. Saeger, where a plant was run at Hensy, in Belgium, for an entire year without any cleaning whatever of either the engine or gas apparatus, and the deposit of foreign matter found at the end of this period was inappreciable. The reliability of the Pintsch producer was proved in one instance, where a 50-H.P. Deutz gas engine was, through necessity, run continuously night and day for nine months without a single stop for any cause whatsoever.

Already the suction gas plant has found a place for marine purposes, in which case special attention is given to reducing the weights of all parts of the gas plant and gas engine to the minimum; these qualifications have also led up to the application of suction gas for propelling road vehicles, where reliability combined with lightness is of special importance.

ELECTRICITY AND DESTRUCTOR WORKS.

A. J. ABRAHAM, A.M.I.E.E., Electrical Engineer, Lanark County Council.

IN small towns a combined electricity and destructor works is likely to prove a great success, especially in small residential towns where the refuse is generally of a good quality. The refuse must be destroyed, and in small places the cost for its destruction will average quite 1s. 1d. per ton, whether the heat is used or not. Taking a number of towns with an average population of 20,000, and an electricity works which has been running four years, we find :—

Average number of houses	4,000
Average tons of refuse destroyed per annum	4,680
Average units generated per annum... ...	200,000

In Cambuslang electricity and destructor works we have as yet no battery, and on this account our destructor is badly handicapped, as we have to run machinery from refuse for 24 instead of 8 hours per day. This means that instead of banking fires for 16 hours daily and burning refuse to the very best advantage for the remaining 8 hours, we have to keep engines running round practically light for 16 hours a day, and this naturally wastes a great deal of refuse. In spite of the above disadvantages, with 72 tons of refuse per week we generate some 2,520 units by refuse, leaving only 716 units for coal. This works out at 35 units per ton of refuse destroyed. During eight-hour tests we have generated 97 units per ton of refuse with cold feed water, but, of course, if destructors were always worked as for a test, neither they nor the firemen would last long. Our destructor has been working since June, 1905, and not one penny has been spent in repairs; moreover, the whole destructor is to-day in excellent order. With a battery I am quite sure that it would be an easy matter to generate under ordinary working conditions 50 units per ton of refuse, and at the same time to reduce the cost of burning it. I mention the above because I think that in any place it will be quite safe to rely on an average of 40 units per ton of refuse destroyed, provided that the station is properly designed for the purpose of working with a refuse destructor. The boilers should be worked at a steam pressure of 200 lb. per sq. in., and the engines should be supplied through a reducing valve with steam at 150 lb. per sq. in.; a good-sized battery is also an absolute necessity. The two smallest sets should be steam balancers if the scheme is a three-wire one. However, in small compact towns a simple two-wire system is the better for several reasons, and I think that the three-wire system is very often put in when a two-wire network would have answered the purpose far better.

Out of the 200,000 units per annum generated in a small town of 20,000 inhabitants, burning 4,680 tons of refuse per year, 187,200 of these can be generated by refuse, which means an annual saving of something like £400 in coal. It would, therefore, be a good thing for the electricity department to pay to the destructor department, say, £240 a year. This sum would more than cover the labour cost for the destruction of refuse, and in a small scheme the other destructor costs would not be increased.

Combined electricity and destructor works installed in large towns, or even smaller towns of, say, 40,000 or 50,000 inhabitants have, in all cases up to the present, been a failure or a comparative failure, and the more the load grows in the electricity part of such schemes the greater will be the necessity for moving the destructor away.

As perhaps the best example of a large combined scheme, Hackney, a borough with a population of over 200,000, may be taken :—In 1905 Hackney works generated 2,915,867 units; the destructor destroyed 37,554 tons of refuse.

It will be seen that of these 2,915,867 units (taking into consideration banking fires &c.) certainly not more than 1,500,000 could have been generated by refuse. Yet for steam to generate these 1,500,000 units the electricity department paid £2,213, and for steam to generate the 1,415,867 units the coal only cost £1,186.

Nobody will, in view of these figures, dispute the fact that, had coal alone been used at Hackney, some thousands of pounds would have been saved in working expenses to the Electricity Department.

Moreover, the wages of the staff at Hackney engaged solely upon the destruction of refuse amounted to the enormous sum of £3,420; so that it cost this destructor 1s. 9d. per ton in labour alone to destroy the refuse. Surely, considering the large amount of refuse handled, this is an excessive amount. They only got £2,213 for their steam, and had to spend, in addition to the above-mentioned labour costs, the sum of £800 per annum for carting away their clinker. If the Hackney destructor had not been combined with the electricity works refuse could easily have been destroyed at a labour cost of 9d. per ton, bringing the figure of £3,420 down to £1,408, or, in other words, saving over £2,000 a year in labour alone, and something not far short of £3,000 a year altogether. As evidence of the above statement, I will compare Hackney with the smaller town of Croydon, where the destructor is placed away from the electricity works :—

	Hackney.	Croydon.
Labour cost per ton refuse destroyed	1s. 9d.	10d.
Inclusive cost per ton	3s. 6d.	2s. 3d.
Refuse destroyed (tons)	37,554	27,750

Wages in Croydon will, if anything, be higher than they are in Hackney.

At Preston Corporation tramways a very different state of affairs exists. During the ten weeks from the week ending January 4th, 1905, to the week ending March 8th, 1905, something like 186,000 units were generated by refuse, and not more than 4,000 units by coal. These remarkable results, together with an excellent load factor, account for the good profits. Now, if this destructor had been joined to the Preston Electric Light Works, the result would have been a failure, owing to the heavy lighting peak of over

1,000 KW., as compared with the maximum load of the tramways, which was about 300 KW.

The electricity and destructor works of Mexborough and other small towns are a distinct success, where both the electricity and destructor works benefit by the combination.

Partick is a good (or shall we say bad?) example of a medium-sized town with 64,000 inhabitants. For it has been clearly proved that the destructor here ought never to have been combined with the electricity works. It is a burden and nuisance to the electrical portion of the plant, and the destructor department is, as at Hackney, placed at a great disadvantage, and has to pay a large sum for the destruction of refuse. If the electricity works at Partick had been left alone, and the destructor placed about 1½ miles away, a lot of money would have been saved to both departments.

On Tuesday, January 13th, 1903, and Wednesday, January 14th, 1903, the Manchester Steam Users' Association carried out tests on the Meldrum destructor at Nelson. The authority of this test cannot be questioned, so that I think it will be of interest to those who have not come across it.

ANALYSIS OF GASES, &c.

	Tuesday.	Wednesday.
Nitrogen, per cent.	79·525	79 888
Oxygen, per cent.	8·140	5 836
Carbonic acid, per cent. ...	12·205	14 233
Carbon monoxide, per cent.	·130	·043
	100·000	100·000
Furnace temperature ...	2,370° F.	3,100° F. Nickel melted.

BALANCE-SHEET OF HEAT EXPENDITURE.

	Tuesday.				Wednesday.			
	B.T.U.	B.T.U.	%	%	B.T.U.	B.T.U.	%	%
Steam (useful) ..	—	1,479	—	42·57	—	1,593	—	29·45
Steam blast ..	190		5·53		220		4·07	
Less heating to 338° F.	23		·67		26		·48	
	167		4·86		194		3·59	
Warming waste products, including steam and moisture from atmospheric temp.	722		20·73		985		18·19	
Heat carried up chimney.	889	889	25·59	25·59	1,179	1,179	21·78	21·78
Heat in ashes ..	172		5·01		147		2·72	
Unc'nsumed carbon	606		17·40		828		15·30	
Lost with ashes ..	778	778	22·41	22·41	975	975	18·02	18·02
Radiation and losses unaccounted for		327		9·43		1,664		30·75
Calorific value of fuel.		3,473		100·00		5,411		100·00

During the above test a costly electric platinum wire resistance pyrometer was lowered into the combustion chamber where the gases entered the boiler, and was destroyed! One of the mercury nitrogen pyrometers in the end flues burst on account of the temperature exceeding 1,000° F. It was replaced by a Thalpotassi-meter, in which temperature is indicated by the pressure of mercury vapour.

It will be seen by the above extract from this test that up-to-date destructors can be placed in the centre of any town without fear of nuisance caused by the burning of any kind of refuse. This fear has caused many smaller places to build their destructor some distance from the centre of the town. Consequently either the destructor has been left by itself, or the electricity works has been placed at a disadvantage on account of distribution costs. Even if the destructor is simply a destructor, it is advisable to place it in a central position, or the cost of collecting refuse is likely to be expensive, as many ratepayers have found out.

It may be necessary for me to add that when I speak of combined destructors and electricity works in large towns as being a failure, I do not mean that the destructor in itself is a failure, but merely that it has been installed in the wrong place. In large go-ahead towns the electric light load comes up to such an extent that the steam from the destructor is a negligible quantity. In larger towns, for a combined electricity and destructor scheme, at least twice the refuse which the town is able to supply is required.

If such a town could obtain the refuse from a neighbouring city on suitable terms, then I think there is no reason why the electricity supply should not be provided almost entirely by refuse and be as successful as in small places.

The following are some particulars of electricity and destructor works costs per ton of refuse destroyed :—

	Fulham.	Partick.	Hackney.
Oil, waste, water, stores ...	1·5d.	0·75d.	0·3d.
Electricity for lighting and power	2·6d.	1·3d.	4·5d.
Wages of workmen	23·8d.	24·5d.	22·1d.
Repairs and maintenance ...	2·7d.	*	2·9d.
Clinker disposal	0·6d.	2·25d.	0·1d.
Rates and taxes	*Nil.*	2·0d.	1·8d.
Management...	6·1d.	1·0d.	1·5d.
	37·3d.	31·80d.†	33 2.
Interest on loans	5·2d.	18·5d.	6·6d.
Sinking fund...	8·9d.		5 2d.
	51·4d.	50·3d.†	45·0d.

* Cannot get at, but large. † Plus repairs and maintenance.

The above figures are rather old, but that fact is in favour of the works in question. The wages cost per ton destroyed (and other things) it will be noted are enormous and far in excess of those of destructors pure and simple installed in *all* other large towns. This fact, as I pointed out before, is due to the mistake of combining the destructor with the electricity supply works.

As regards the type of destructor, I have had working experience of both top and front feed cells. The former are most objectionable for the following reasons :—

1. They are far more expensive to work than front feed for one reason only, because when steaming, men are required both on top and at the fires. In front feed the same men can stoke and clinker out, and the labour cost is almost halved.

2. The refuse tipped on the hot cell tops is a nuisance, being unhealthy and unpleasant (although by top feed makers this is put forward as an advantage), and the job of pushing this filthy live fuming stuff into the top door is not a fit one for any human being.

3. The top door is often troublesome to keep in order, and generally fills the building with sulphur fumes.

4. The fewer openings there are in a cell the better, and no openings are advisable in the furnace crown, for obvious reasons.

Drying grates are also offensive for the reasons given (2) and (4). No drying grate is required where a regenerator is fixed, as, with the latter, even wet closet refuse can be destroyed in a quick and sanitary manner.

Persons who have never worked a front-feed destructor all have the same old tale, *i.e.*, that the front of the cells must always be in a dirty condition. This, however, is far from being the case. A front-feed destructor is in all instances cleaner, more wholesome and far more easily worked than a top-feed, or the dirty unscientific drying grate method. Moreover, it is actually a disadvantage to dry certain kinds of refuse, as when dry the calorific value decreases. It is commonly supposed that where coal is cheap refuse is good. In Cambuslang, however, coal is cheap enough, but the refuse is of a very bad quality all the year round. Places where houses are big and servants plentiful, are the very best for refuse and electricity supply, no matter whether coal is cheap or expensive!

Manchester Tramways.—The poll of the ratepayers, to decide as to the inclusion of various new lines of tramway in the Corporation Bill which is to be presented to Parliament in the coming session, took place on Saturday last. The votes were counted on Monday, and the result then declared. Comparatively little interest seems to have been taken in the event, for only some 12,000, out of a constituency of 120,000, took the trouble to give their votes. All the Tramways Committee's proposals were sanctioned, by large majorities, so that the Bill will go through intact, including the road widenings on the Sale and Northenden route, which are of some importance.

REVIEWS.

Alternating Currents. By C. G. Lamb, M.A., B.Sc. London: Edward Arnold. 1906. Price 10s. 6d. net.

The author lectures to engineering students at Cambridge, and has experienced difficulty in recommending a suitable text-book. Electrical engineering is only one of the subjects required for the Mechanical Science Tripos, and so the student has not the time to study any of the larger books already available, and the smaller books do not cover the ground. It was therefore felt that a compilation of the more important points was desirable.

We are not quite convinced by the author's statement in his preface that references in a book of this kind are merely distracting to the student and "to the more learned person" are unnecessary. For instance, the reviewer has to confess that he was ignorant of M. Renzelman's (p. 258) theory of armature reaction, and it would have saved him trouble if references had been given. The author finds that the symbolic treatment appeals to a very limited number of students. He has therefore not used it. He has also not given any descriptive detail of machines, as this is more profitably obtained—"either by actual contact with drawing-office work, or by careful perusal of the contemporary technical Press." Modesty prevents us from more than merely endorsing the latter half of this remark.

A knowledge of general electro-magnetic theory is assumed, as well as the elements of the calculus and the elementary properties of vectors. The author also assumes that the reader knows "the laws of eddy currents." The reviewer has, unfortunately, to confess his ignorance of these laws. Possibly the tripos men, for whom the book is specially written, have attended lectures on them. Prof. J. J. Thomson has written a good deal on eddy currents, but it is very laborious reading to any but a mathematician.

In accordance with the usual custom a list of symbols is given, and most of them are novel to us. This is as it should be. An author who thinks for himself is at first "cribbed, cabined and confined" by the more conventional symbols, and those people who complain about having difficulties in following reasoning because of the symbols used are exceedingly unlikely to be able to follow it, whatever symbols are employed.

The ground covered is very much the same as in Steinmetz's work, but there is less analysis and more geometrical constructions. The keynote of the work is practical utility, especially for Tripos examinations, and the author seldom leaves the beaten track. Unlike the books which emanate from the Cavendish Laboratory School, there is little attempt at literary elegance, and the author seldom points out the limitations of the theory. The plain solid fare set before the reader will be appreciated by the student anxious to masticate nothing, however sweet to the taste, the examinational value of which is doubtful.

There are several theoretical points touched on by the author which are open to criticism. For instance, on p. 30, he revives the old theory about equivalent sine curves! To illustrate the difficulties of this theory, let us consider the alternating-current arc. Its power factor is not unity, and yet the current and the pressure vanish simultaneously. In replacing them by their equivalent sine curves, do we put the current lagging or leading, and if so, why? We thought that at Cambridge they were in the habit of representing jagged waves by a series of vectors rotating at different speeds—a method, we believe, originally used by Steinmetz. With this method it is easy to show how condenser and choking-coil currents vary with the shape of the applied wave, and hence it is of practical value.

In discussing the core loss in a transformer, the assumption is made that the eddy-current losses vary as the square of the maximum value of the induction density in the core, and the conclusion is drawn that if the frequency and pressure be constant, the total loss of energy will be very nearly constant at all loads. This states the matter very crudely. The energy lost varies in a very special manner with the shape of the applied wave and the magnetic leakage, and a *résumé* of the results of certain classical experiments would surely have been helpful to the student.

On p. 37 it is stated that the correcting factor of a wattmeter is only unity when the inductance of the shunt circuit is zero, but the formula given shows that it is also unity when the time constant of the shunt circuit equals the time constant of the load. The author very frequently uses the phrase it can "readily be seen," when passing over mathematical difficulties. This after a time discourages the very deserving class of readers who hate passing over difficulties, as it gives them the impression that they must be hopelessly stupid.

A neat proof is given that when the power-factor of an alternating circuit is unity, the shapes of the waves of current and pressure must be similar. It is stated that in this case there must be merely resistance in the circuit—"Under no other circumstances can a circuit be without a power-factor" (p. 32). We presume that the author means that under no other circumstances can the power-factor be unity. Prof. Perry, however, has shown how to combine capacity, inductance and resistance so as to get a power-factor of unity. The author defines slip as the relative angular velocity between the rotating field and the rotor. We much prefer to define it as the ratio of this relative angular velocity to the angular velocity of the field. This is the number that engineers want. It is clumsy to call it the "fractional slip," and wrong to call it the "fractional angular velocity" (p. 8).

The author uses some curious words: "antiphased," "parallelising," "deceleration," "apparatus connection," "optimum," "locked characteristic," "let the rotor be blocked." We presume that the following are misprints (p. 290), "to continue to act *at one* as a motor" (alone?), and (p. 119) "the constants of the supply circuit . . is . ." We have noticed a good many misprints in the book. There are also some obvious misprints or slips in the mathematical equations on pp. 155, 198, 278, 307 and 308.

Electrical Engineering in Theory and Practice. By G. D. Aspinall Parr. London: Macmillan & Co., Ltd. Price 12s. net.

It would perhaps have been better had the author marked this book "Volume I," as it is his intention to deal at a later date with the matters which are not touched on in the present work. By "Electrical Engineering" it is commonly understood that the generation, transformation and distribution of electricity are included, whereas the present book does not touch on these points at all, but deals only from a practical standpoint with instruments, arc and incandescent lamps, and accumulators. The theoretical part of the book deals with the fundamental facts of magnetism and electricity. As a general rule, reviewing a book of this nature is a somewhat tedious matter for the reviewer, but it is a pleasure to meet with an author who not only is master of his subject but also writes in clear language and in good English.

The ordinary student's conception of statical electricity is that the electricity is generated by rubbing two dissimilar substances together, and that the amount of electricity produced bears some kind of relationship to the energy expended in the rubbing. The author, however, makes it clear that in his view the rubbing is only necessary in order to bring the various parts of the dissimilar bodies into intimate contact, and that the actual origin of electrification lies only in the contact of dissimilar substances and not in the rubbing itself. The following extract bearing on this point will serve to give an idea both of the author's mode of treatment of the subject, and also of the clearness of the language employed:—

"By employing suitable precautions it can be shown that if two insulated conductors be put simply in contact, each becomes fully though feebly electrified, though no rubbing has taken place, and no increase in electrification would be produced if they were rubbed. This, coupled with the fact that any two substances of the same nature show no signs of electrification when rubbed together, indicates that the actual origin of the electrification considered in the preceding pages, lies in the contact of dissimilar substances, and not in the rubbing.

"When, however, one or both of the substances are bad conductors, it is absolutely necessary to rub them together in order to bring the various parts of the surfaces of the

two bodies successively into intimate contact, which is the sole object of the rubbing.

"Moreover, the electrical energy stored up in the rubber or thing rubbed, after they are separated, is the equivalent of the work done in separating them against the attraction which the two kinds of electrification thus produced have for each other. Thus, the degree of electrification obtained does not in any way depend on the rubbing in itself, but solely on the nature of the two substances, and the efficacy of their contact."

Equally clear is the author when dealing with the fundamental principles of current electricity, and in explaining —what to a student is always a difficulty—that whilst we speak of a current of electricity, there is actually no flow from one point to another.

Dealing with electro-magnetism, the author gives typical illustrations of the various forms of electro-magnets, and carefully describes the characteristic properties of each. The calculation of magnet windings is also gone into, and examples given.

In the section on electro-magnetic induction, the student will find the subject treated with unusual clearness, and will, probably for the first time, get a very good conception of what is meant by a "Henry." The way in which the author gradually develops the formula for self-induction in a coil (on page 198) is particularly concise.

Modern forms of electrical measuring instruments are well described and illustrated with up-to-date blocks, following which, incandescent and arc lamps receive adequate treatment. Here, again, the author describes very clearly what one seldom sees in books of this nature, the precise functions of economy and balancing coils in connection with alternating-current lamps, and he shows by numerical examples how the economy is effected.

In the section on batteries, the leading types are accurately described and illustrated, although the author is, perhaps, not quite correct in describing the Chloride plate when he says that the rosettes are subjected to a pressure of about 200 tons in order to expand the rosettes into the countersinking of the plates. We understand that this is not now the case, but that the expansion of the rosettes in process of formation is all the expansion that is used to hold them in place.

As mentioned before, it has been a pleasure to us to peruse this book, and we can cordially recommend it to the student; we shall look with equal pleasure for the promised volume on generation and transmission.—F.B.

Central Station Electricity Supply. By Albert Gay, M.I.E.E., and C. H. Yeaman., A.I.E.E. Second Edition. London: Whittaker & Co. Price 10s. 6d.

This book, the authors tell us, does not come within the category of those which are written by people having no practical acquaintance with the subject. It is a book on central station practice written by two central station engineers of many years' experience.

After a brief introductory chapter dealing with the historical aspect, the authors discuss Powers and Regulations, following this up with a chapter on the general design and features of a generating station. After dealing fully with the several methods in vogue of charging for electricity, the various systems of supply are referred to in detail, ranging from the two-wire continuous to the polyphase system with sub-stations.

There are about a dozen appendices to the book, and these contain more information of a useful nature to the central station engineer than is contained in the same space in any other portion of the book. Among other matter included in the appendices is a list of fatalities in Europe due to electric shock between 1880 and 1889, and in England between 1892 and 1905, with cause of death. Definitions of terms employed in provisional orders, summary of requirements, of B. of T. regulations and standards proposed by the Engineering Standards Committee are given.

The chief fault of the book is that it is far too general, and a considerable portion of it might be deleted without impairing its value.

It might have been assumed by the authors that an electrical engineering student who had got to the stage of "central station supply" would know at least the fundamental facts concerning electrical engineering. The first dozen or so pages of the chapter on "Direct Systems of Supply," for instance, apply equally to any electrical installation. Here we are taken through the elementary stages of distribution, starting with the dynamo supplying a single lamp, followed by the ancient tree system, then parallel and reversed main systems. Referring to the latter, the authors say "the 'Werdermann' system, combined with tapering conductors, gives an almost perfectly uniform pressure." This is, of course, true, but the uniformity exists only so long as the number of lamps in circuit remains unchanged —a condition of things which does not obtain in a general distributing system.

Again, it ought not to be necessary to explain to the reader of a book on central station supply that a Planté storage cell "consists in its simplest form of two plates of metallic lead immersed in sulphuric acid," &c.; and that, in the Faure cell, the lead plates are perforated and filled with lead oxide and litharge, together with other elementary details of this nature. This irritating recital of first principles runs throughout. Thus, "the object of a switchboard is to form a connecting link between the dynamos and the outgoing mains." Referring to switches, we learn that "on rupturing a circuit when the current is flowing, the device employed is liable to suffer due to the spark or arc at the contacts as they leave one another"; "fuses are inserted between the station bus-bars and outgoing feeders for the purpose of automatically disconnecting a faulty feeder." Referring to the possibility of reverse currents through a generator, we are told that "unless this backward flow can be restricted, unnecessary damage may be done." Surely all damage is unnecessary!

On the subject of street lighting, the authors again think it desirable to start with first principles and take us back to the days "when each individual ratepayer was required to lighten the darkness by means of a tallow candle or spluttering oil lamp, fixed in a horn lantern and suspended outside his house." This is entertaining, and would be quite an appropriate introduction to a book on the history of illumination—but this is a book on "Central Station Supply." Enclosed arc lamps are discussed in exactly 11 lines, in which it is stated that at least one type of alternating enclosed lamp is "in experimental use."

Speaking generally, the book gives a good general notion of the essential features of electricity supply from central stations, but will be more useful to the student than to the central station engineer.—F.B.

THE CONTRACTING MANUFACTURER.

By BEN FRANK.

There are still a few of the pioneer firms who started as electrical contractors in the early days of the industry and have since, by force of circumstances, developed into manufacturing concerns, who have not yet fallen into line with the ideas of the N.E.M.A. or the N.E.C.A. Such firms are, however, being gradually brought into the fold of one or other of these associations, and among the recent notable converts is the firm of Grindell.

I happened to run up against Tom Grindell at Frascati's one evening a few weeks ago.

"Hello, Benjamin," said he—he knows I hate to be called by my baptismal name—"and what brings you *here*, the world, the flesh, or the devil?"

"Is it a conundrum?" I returned, "If so, I give it up. But if it is information you want I can best answer your elegantly phrased question by saying that I suppose we are both here on the same errand."

"Now, now," said he, thinking he had rather ruffled my feathers, "don't let us fall out so soon in the new year. Come and have a drink."

After having drunk to the health of each other and to the

new year in the concoction affectionately spoken of as "Johnny Walker," I chaffingly said: "So you have turned over a new leaf with the new year, I hear; 'been and gone and joined 'em' have you?"

"Joined who? What are you driving at?" It was obvious that Grindell did not tumble to my meaning, so, to be more explicit, I said: "Well, I hear that you have decided to give up contracting work, and that in future we shall see the N.E.M.A. shield on your stationery. Is that so?"

"Oh! I see your drift now. Well, I can't say that we have decided absolutely to give up contracting work; fact is, I don't see how we can. The tendency is for people to go direct to the manufacturer, and make him responsible, on a contract of any size. Of course, I refer to power installations, not to lighting contracts. How anyone can make a living out of lighting work is a mystery to me. The few contracts we have put in for lately have been taken at prices below what it would have cost us for material, and I am certain we can buy as cheaply as anyone. Do *you* know how it is done?"

"Well, I have my ideas, of course, and I know what other people say. Some firms put in a cheap price and pile up extras; others put in inferior stuff——"

"But," interrupted Grindell, "a man can't put in inferior stuff when he his working to a specification—that is to say, if the consulting engineer is honest and inspects the work properly; and I must say that those I have worked under generally want their pound of flesh."

"Of course, being only a layman, so to speak, I am not in the know, but I was talking to Lawton the other day—you know Lawton, don't you, he is Berling's outside manager—his firm had quoted for a pretty extensive contract and lost it. As he had put in a cut price for the work he had the curiosity to walk through the building later on to see what kind of a job his competitors were making of it, when he happened to notice a label on one of the coils of cable. The makers were a firm he had never heard of—'That's a strange thing,' he said to himself, 'I could swear that "Association" cable was specified.' As a matter of fact, he had quoted on 'Association' stuff, and turned up his copy of the specification on returning to the office to see if he had made a mistake."

"And what did he find?" said Grindell, who appeared to be deeply interested in my little anecdote.

"He found, or at any rate thought he found, that he was right, and that 'Association' cable had been intended. So Lawton telephoned up to the Consulting Engineer's office and asked if he had correctly interpreted the specification. The reply was, 'You correctly interpreted the spirit of the specification and my intentions. I *meant* Association cable, but unfortunately your competitors have taken advantage of a slight ambiguity in the wording.' 'Well, it reads plainly enough to me,' said Lawton, 'and we quoted Association cable. I could have quoted about £50 lower for "Non-Association" quality, but I never thought for a moment that you would accept it.'"

"I wonder what job it was; probably we were in for it, too. But we never use 'Non-Association' cable. You can't have different qualities of cable in the stores; they are sure to get mixed and land you into trouble. Did Lawton tell you what the loophole was?"

"Yes, it appears that the wording of the specification was something like this—I can't give the exact words: 'The cable is to be equal in quality to that known as "Association" quality of the C.M.A.' You see, it did not say that it must be 'Association' cable, but *equal to it*, and I understand it is a difficult matter to prove that one cable is not as good as another; anyhow, the consulting engineer thought that, on the legal point, he had not a certain case, so accepted a long guarantee."

"Well, I'm——! If it was not so early in the new year I should have said something. I should not be a bit surprised if we were in for that contract, too. He's a smart chap, that Lawton. But to come back to the point, where are you going to draw the contracting line over which manufacturers must not step? Would Willans, or Belliss, or any other engine-building firm decline to quote for engines to anyone but contractors? Would they decline to erect an engine, and say, 'Oh, no; that is contractors' work?'"

"As I understand it," I replied, "contractors allow a manufacturer to erect his own plant."

"The deuce they do. That's beastly kind of them. Then firms like Dick-Kerr or Siemens are allowed to erect their own dynamos, I suppose, but not a coupled plant? And as a motor is first cousin to a dynamo, they might go so far as to let us erect our motors then?"

"Oh yes, that is quite understood, I believe."

"But a motor is no good without a starter, a D.P. switch and its bit of wiring, and who is to put these things up? And suppose there are several motors; it may mean distribution boxes, switchboard and all sorts of things. Must we sublet to a contractor the erection of everything we don't make?"

"Now you are getting beyond me; I know that the spheres of operation are pretty well defined, but I can quite see that a purchaser might reasonably object to allow half-a-dozen manufacturers each to erect his own particular speciality on an installation. Somebody must clearly be responsible for the whole job, and that it seems to me is where the contractor comes in."

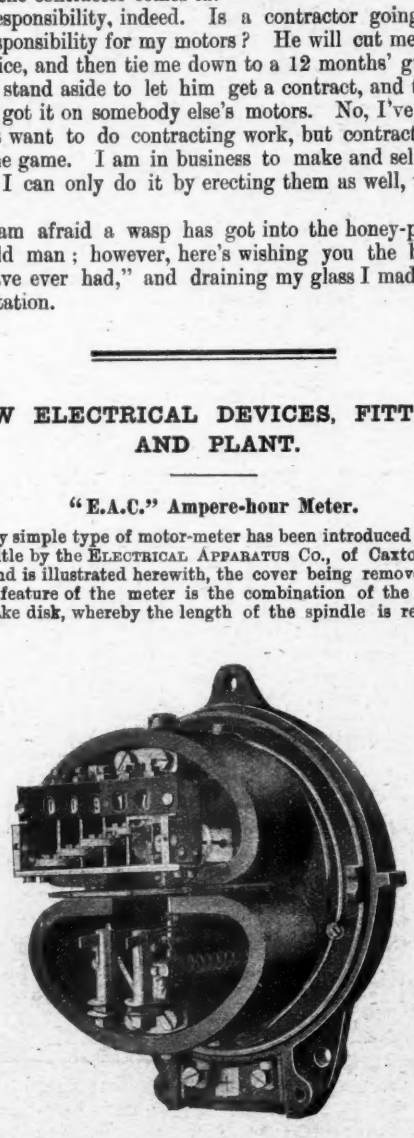
"Responsibility, indeed. Is a contractor going to take any responsibility for my motors? He will cut me down to cost price, and then tie me down to a 12 months' guarantee. I may stand aside to let him get a contract, and then find he has got it on somebody else's motors. No, I've tried it. I don't want to do contracting work, but contractors must play the game. I am in business to make and sell motors, and if I can only do it by erecting them as well, very well then."

"I am afraid a wasp has got into the honey-pot somehow, old man; however, here's wishing you the best year you have ever had," and draining my glass I made for the Tube station.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

"E.A.C." Ampere-hour Meter.

A very simple type of motor-meter has been introduced under the above title by the ELECTRICAL APPARATUS CO., of Caxton House, S.W., and is illustrated herewith, the cover being removed. The special feature of the meter is the combination of the armature and brake disk, whereby the length of the spindle is reduced to about 2 in. The armature consists of a series of flat coils supported on a disk shaped like the figure 8, and revolves between the permanent magnets, which also provide the braking effect.



"E.A.C." AMPERE-HOUR METER.

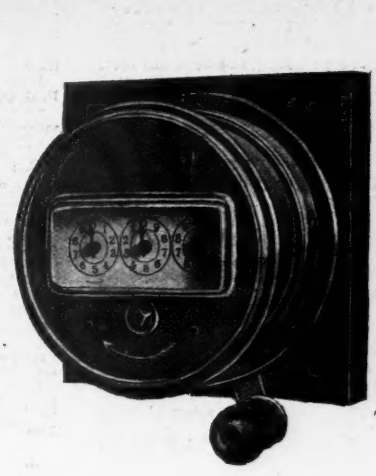
The commutator, which is made up of four segments, is of extremely small diameter, thus reducing the brush friction to a minimum. The brushes themselves each have two knife-edge contact surfaces, the object being to transform a very light total pressure into a comparatively high pressure per sq. in. of bearing surface. This makes it impossible for any foreign matter to separate the brushes from the commutator, and thus stop or retard the action of the meter.

The field consists of two semicircular magnets with the pole bent inwards, giving a large pole-face area and providing a nearly closed magnetic circuit. These magnets are made of highest-grade magnet steel, thoroughly aged; the utmost care is taken to ensure permanent magnetisation, and a slight variation in the flux density will not greatly affect the accuracy of the meter, for the armature and the brake disk being combined, any variation would affect both of them somewhat similarly.

The moving element is extremely light, weighing not more than 20 grammes. The inertia, therefore, is very small, and the meter starts at considerably less than 1 per cent. of full load current, with only a small drop in volts, produced by a shunt consisting of two turns of resistance wire of negligible temperature coefficient, across which the armature is connected. This shunt passes round the inside of the meter, giving it a maximum amount of cooling surface. In meters of over 30 amperes capacity the shunt is enclosed in a separate cover outside the meter, but on the same base.

The registering mechanism is of the spring figure type, of a specially patented construction, which, it is claimed, has only one-tenth of the friction of the ordinary counters generally used for this purpose. For convenience of testing, the meter can be read to two places of decimals, the decimal portion of the counter being painted red. Each dial is marked with the number of revolutions required to register one B. of T. unit at a given voltage.

Owing to the lightness of the armature, it is not necessary to clamp it for transport, and, therefore, the case need not be removed when fixing the meter.



The "Guest" Meter.

Electric Cigar Lighter.

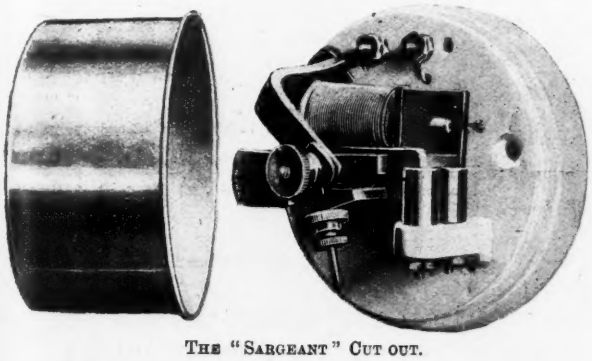
New Cut-Outs, Meters, &c.

A novel device which is largely used abroad, and is being introduced into this country by the Warner Engineering Co., of 11, Dartmouth Street, Queen Anne's Gate, S.W., is the cut-out known as the "Sargeant," illustrated herewith. In this apparatus a bridge piece spans two mercury cups; this bridge piece is raised out of the cups through the attraction of an electro-magnet on its armature, whenever the current passing through the magnet winding exceeds a defined limit.

The difference between this apparatus and the similar well known form of cut-out is, that while with the latter the interruption is maintained as long as the excess of current, in the "Sargeant" the magnet winding is in series with the break, and no sooner has the break taken place than the bridge piece drops and re-makes the circuit. It will thus be seen that the bridge piece jumps up and down when there is an excess of current, giving a rapid series of interruptions and avoiding such a complete break of the circuit, as an ordinary fuse would give.

The principle use to which the "Sargeant" is being put, is to regulate the use of electricity in workman's dwellings, the idea being to wire a workman's dwelling for four or six lamps, and without the use of a meter to limit the supply to two or three lamps alight at any instant. It is claimed by the makers that by substituting a "Sargeant" for a meter costing several pounds, and expensive to maintain, that four 8-c.p. lamps, limited to two alight at the same time, can be supplied in a small office or dwelling for 6d. per week, the consumers finding their own lamps.

Many other uses naturally suggest themselves for this compact piece of apparatus, and the claim of the makers, that by its use every supply engineer can add 20 per cent. of small consumers to



The "Sargeant" Cut out.

his books, is worth consideration at the present time. The base of the cut-out is of glazed porcelain, while the whole is of first-class workmanship, and so arranged that with the metal cover on, it may be sealed with the supply company's seal, so as to render tampering practically impossible.

The same firm is placing a well finished combined switch on the market, known as the "Guest," which we also illustrate. This meter is best understood if it is considered as an ordinary switch, from the dial of which readings can be taken showing the number of hours the switch has been "on."

The "Guest" was originally designed for electric signs, placed at a rental on buildings, and supplied with energy from the existing lighting mains. Since all supply companies allow a special power rate for radiators, &c, it will be seen that the combined switch and meter, for this or any purpose where the watts are constant, forms an inexpensive and accurate means of measuring the amount to be charged on the power rate.

Supply engineers who erect and maintain lamps at an inclusive hourly charge should find this switch meter the simplest means for integrating the hours that the lamps are in use.

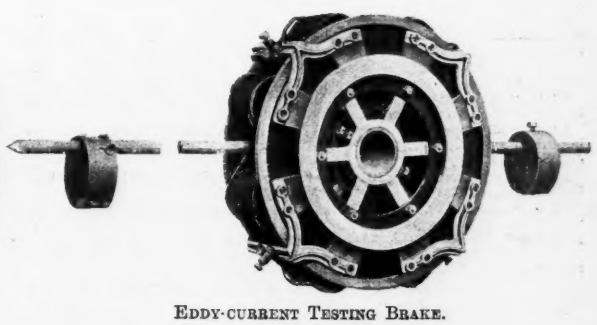
Each meter is supplied with a key, and runs 255 hours without re-winding.

A similar meter to the "Guest," known as the "Lodger," having instead of the switch an electro-magnetic device for starting and stopping the meter when the current is put on from an independent switch, is also supplied by the Warner Engineering Co., and it is obvious that its uses are similar to that of the "Guest," both names indicating that they are an auxiliary or sub-meters.

Another useful novelty supplied by the company is an electric cigar lighter. This consists of a plated lamp burning petrol or any mineral essence of low flash point. A simple arrangement consisting of a pair of dry cells, an induction coil and small steel brush, enables a spark to be produced which ignites the lamp automatically. Since no current is used, save at the moment of ignition, the arrangement is extremely economical. The device can be fastened to a wall, energy being obtained from any pair of existing Leclanché cells.

Eddy-Current Brake.

Messrs. Morris & Lister, who, as announced in our "Business Notes" to-day, have commenced manufacturing operations at Carlton Works, Coventry, are making their patent eddy-current brake for testing electric, petrol and other motors. The accompanying illustration is from a photograph of a 12-h.p. brake. This new pattern of electro-magnetic brake, to which reference has already been made in the Electrical Review, is designed to absorb the output of motors, and to measure it accurately and with



Eddy-current Testing Brake.

ease. It consists of two copper disks mounted on a bush which can be keyed to the spindle of the motor to be tested. Between these disks, and acting as a floating central hub, is an aluminium casting which carries the magnetising coils, the external yoke rings, and the graduated and balance levers. The coils are excited by a d.c. supply, and produce a powerful multipolar magnetic field in the gap in which the disks revolve. Eddy or Foucault currents are generated, and the output of the motor is thus expended in heating the copper disks. The strength of the induced currents, and therefore the b.h.p. absorbed, depends upon the intensity of the magnetic field, and this is readily controlled by means of a rheostat in the exciting circuit. The forces resulting from the inter-action between the magnetic field and the induced currents in the disks will tend to drag the floating system round. The force is, however, opposed by

a gravitational force, due to the weighted lever. When these two forces are equal, the lever will float between its stops. The torque or turning moment exerted by the motor in lb.-ft., is then equal to the product of the weight in pounds into its radius of action in feet. In a circular which has just been issued by the firm, a number of practical advantages which are claimed for the apparatus are stated. Diagrams showing dimensions and particulars of prices are included.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

7,836A/06. "Improvements in magneto-electric ignition apparatus for internal combustion engines." The Electric Ignition Co., Ltd., and F. H. Hall. (Date applied for under Rule 5 of the Patents Rules, 1905, April 2nd, 1906.) January 15th.

917. "Electro-magnetic method of change speed gears for automobiles and the like." G. A. Tucker. January 14th.

919. "Improvements in electric clocks." I. H. Parsons and A. E. J. Ball. January 14th.

927. "Improvements relating to switches in the cap of incandescent electric lamps." J. Metcalfe. January 14th.

944. "Improved method of securing underground cables for electric tramways and the like and connecting apparatus therefor." J. L. Merini. January 14th. (Complete.)

975. "Improvements in means for compounding and regulating direct current dynamo electrical machines." Felten & Guilleaume-Lahmeyerwerke Act.-Ges. (Date applied for under Patents Act, 1901, January 18th, 1906, being date of application in Germany.) January 14th. (Complete.)

987. "Improvements in and relating to electro-magnets having movable cores." The British Thomson-Houston Co., Ltd., and E. B. Wedmore. January 14th.

995. "Improvements in commutators or distributors of electric current." E. W. Bowen. January 15th.

998. "Electrical Morse signalling lamp." W. H. Millett. January 15th.

1,003. "Improvements relating to auxiliary dynamo-electric machines for equalising the output of main dynamo-electric generators supplying energy to a fluctuating external load." The Lancashire Dynamo and Motor Co., Ltd., F. G. Warburton and A. H. Kelsall. January 15th.

1,006. "Improvements in brush-holders for dynamo-electric machinery." A. P. Wood and The Lancashire Dynamo and Motor Co., Ltd. January 15th.

1,009. "Improved accumulator." C. H. Montgomery. January 15th.

1,016. "Improvements in and relating to ceiling and like 'roses' in connection with electric lighting or the like." G. F. Kenyon. January 15th.

1,034. "Improvements in terminals for electric accumulators, batteries and other electrical apparatus." K. R. Smith. January 15th. (Complete.)

1,049. "Improvements in electro-magnetic clutches." J. Watzke. January 15th. (Complete.)

1,061. "Improvements in or relating to telephone systems." T. W. McKenzie and W. C. Mackenzie. January 15th.

1,070. "Improvements in and relating to electric candle lamps." R. Griffiths. January 15th. (Complete.)

1,080. "Improvements in electric induction furnaces." Societe des Procedes Gin pour la Metallurgie Electrique. (Date applied for under Patents Act, 1901, March 7th, 1906, being date of application in France.) January 15th. (Complete.)

1,082. "Electrical bell-ringing apparatus." F. Fluckiger. January 15th. (Complete.)

1,085. "Improvements in magnetic separators." S. O. Cowper-Coles. January 15th. (Complete.)

1,095. "Improvements in electric current switches." Felten & Guilleaume-Lahmeyerwerke Act.-Ges. (Date applied for under Patents Act, 1901, January 15th, 1906, being date of application in Germany.) January 15th. (Complete.)

1,097. "Improvements in and relating to fittings for electric lamps." E. Schattner. January 15th.

1,098. "Improvements in and relating to the supply conductors of electric railways and the like." The British Thomson-Houston Co., Ltd. (General Electric Co., United States.) January 15th.

1,099. "Improvements in and relating to electric switches." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) January 15th.

1,100. "Improvements in and relating to dynamo-electric machines." J. E. Noeggerath. (Date applied for under Patents Act, 1901, January 16th, 1906, being date of application in United States.) January 15th. (Complete.)

1,140. "Improvements in track brakes for electric railway and tramway vehicles." J. S. Raworth and A. B. Raworth. January 16th.

1,141. "Improved box or covering for lead cased electric cables." J. Stratton and E. A. Claremont. January 16th. (Complete.)

1,149. "Improved gear for operating magneto-electric ignition apparatus on internal combustion engines." B. Lawrence, J. T. Roberts and L. Johnson. January 16th.

1,158. "Improvements relating to time controlled commutator switches." G. Briones. January 16th. (Complete.)

1,160. "Improved device for holding from, and preventing vibration in, the parts of electrical accumulators and for motor vehicles and for other like purposes." W. Peto and Peto and Radford, Ltd. January 16th.

1,162. "Improvements in electrical influence machines commonly called static machines." A. E. Dean. January 16th.

1,177. "Improved process for the electrolytic separation of metals." A. Lenart, Jun. January 16th.

1,191. "Improvements in electric circuit closing devices." J. J. Stockhall, jun. January 16th. (Complete.)

1,195. "Improvements in electrical measuring instruments." P. Hamilton. January 16th.

1,196. "Improvements in and relating to the supports for the filaments of incandescent electric lamps." The British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts-Gesellschaft, Germany.) January 16th.

1,197. "Improvements in and relating to the treatment of refractory materials." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) January 16th.

1,198. "Improvements in and relating to incandescent electric lamps." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) January 16th.

1,199. "Improvements in and relating to incandescent electric lamps." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) January 16th.

1,200. "Improvements in and relating to incandescent electric lamps." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) January 16th.

1,201. "Device for igniting gas lamps by means of electric sparks." E. C. R. Marks. (Aktiengesellschaft fur Automatische Zund und Lösche Apparate, Switzerland.) January 16th. (Complete.)

1,203. "Improvements in electric illuminated signs, advertisements and decorations." H. Michalke. January 17th.

1,232. "Improvements in or connected with electric ignition apparatus." F. H. P. Beatson. January 17th.

1,242. "Improvements in or relating to alternating current commutator motors." Siemens-Schuckertwerke G.m.b.H. (Date applied for under Patents Act, 1901, January 20th, 1906, being date of application in Germany.) January 17th. (Complete.)

1,243. "Improvements in or relating to the starting and regulation of electric motors." Siemens-Schuckertwerke G.m.b.H. (Date applied for under Patents Act, 1901, February 3rd, 1906, being date of application in Germany.) January 17th. (Complete.)

1,257. "Improvements in apparatus for producing alternating electric currents." G. Marconi and Marconi's Wireless Telegraph Co., Ltd. January 17th.

1,264. "Improvements in the manufacture of electrical accumulators." E. M. Miura. January 17th. (Complete.)

1,277. "Improvements in electric switches." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) January 17th.

1,278. "Improvements in and relating to operating mechanism for electric switches." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) January 17th.

1,279. "Improvements in and relating to the control of power transmitting mechanism, in which the power is obtained from an electric generator driven by a prime mover or other source." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) January 17th.

1,280. "Improved means applicable for use in attaching electrical measuring instruments to a switchboard." Hartmann & Braun Akt.-Ges. (Date applied for under Patents Act, 1901, July 5th, 1906, being date of application in Germany.) January 17th. (Complete.)

1,292. "Improvements in and relating to a process for the generation of alternating currents by means of the electric arc." E. Ruhmer. January 17th. (Complete.)

1,293. "Improvements in electric signalling installations." Siemens Bros. and Co., Ltd. (Siemens & Halske Akt.-Ges., Germany.) January 17th. (Complete.)

1,299. "Improved method and means of producing alternating currents of electricity from continuous currents of the same." H. Manders and A. W. Sharman. January 18th.

1,301. "Improvements in and relating to electrical ignition devices for internal combustion engines." E. H. Clift. January 18th.

1,303. "Improvements for using direct-working telephones for inter-communication purposes." E. A. Davis and A. Brookman. January 18th.

1,321. "Improvements in operating electro-magnetic track brakes." A. V. Newell. January 18th.

1,330. "Electric belt." A. Hornung and I. Sperling. January 18th.

1,333. "Improvements in and relating to automatic electric-current takers for locomotors in series." L. Potterat. January 18th. (Complete.)

1,334. "Improvements relating to electrical switches." D. K. Morris and G. A. Lister. January 18th.

1,343. "Improved support for the filaments of electric lamps." A. Green and G. Barton. January 18th.

1,347. "Improvements in or relating to the winding of certain types of dynamo armatures." The Electric Ignition Co., Ltd., and F. H. Hall. January 18th.

1,348. "Improvements in or relating to the insulation of dynamo armatures." The Electric Ignition Co., Ltd., and F. H. Hall. January 18th.

1,356. "Improvements in or relating to devices for regulating pressure of alternating current generators." Ganz & Co., Eisengiesserei und Maschinenfabriks Act.-Ges. (Date applied for under Patents Act, 1901, January 19th, 1906, being date of application in Germany.) January 18th. (Complete.)

1,358. "Improvements in or relating to electric switches." A. L. Ambler. January 18th.

1,362. "Improvements relating to insulators for electric conductors." H. H. Lake. (W. G. Clark, United States.) January 18th. (Complete.)

1,366. "Improvements in electric contact makers and high tension current distributors." S. J. Watson and The Westlake Motor Syndicate, Ltd. January 18th.

1,373. "Improvements in connection with the electric lighting of railway and other vehicles." C. A. Park and C. L. Mason. January 18th.

1,377. "Improvements in or connected with enclosed flame arc lamps." W. J. Davy. January 18th.

1,386. "Improvements in sound transmitting and regulating devices for use with telephones, speaking tubes and the like." E. Senger. January 18th.

1,395. "Improvements relating to insulators for electric conductors." H. H. Lake. (W. G. Clark, United States.) January 18th. (Complete.)

1,397. "Improvements in and connected with the mariners' compass." L. W. P. Chetwynd, F. W. Clark and Kelvin & James White, Ltd. January 19th.

1,401. "Improvements in overhead conductor points on electric tramways." T. Gregory. January 19th.

1,417. "Improvements in condensers for electrical purposes." J. A. Marshall. January 19th.

1,432. "Balanced electro-mechanical tractor equipment alternately or simultaneously receiving or generating its driving power." A. Feron. (Date applied for under Patents Act, 1901, January 20th, 1906, being date of application in Belgium.) January 19th. (Complete.)

1,449. "Improvements relating to the braking of electrically-propelled vehicles." T. Fraser. January 19th.

1,456. "Improvements relating to electric-current transformers." O. de Faria. January 19th. (Complete.)

1,457. "Improvements in or relating to the control of induction motors." M. Milch. January 19th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

Apparatus for Generating and Utilising High-Tension Alternating Currents for the Ignition of Explosive Mixtures in Internal Combustion Engines. L. J. Le Pontois. 26,590. December 20th.

Apparatus for Adjusting the Compass at Sea without Sights. W. Thomson, Baron Kelvin and Kelvin & James White, Ltd. 26,759. December 22nd.

Apparatus for Adjusting the Compass at Sea without Sights. W. Thomson, Baron Kelvin and Kelvin & James White, Ltd. 26,759A. (Date applied for under Rule 5, Patents Rules 1905, December 22nd, 1905.) December 22nd.

Filaments of Incandescent Electric Lamps. A. Bourdos, R. Rothschild and J. W. Sutcliffe. 26,855. December 23rd.